1995-09

# Resistance scaling and predictions of SLICE hulls from model tests

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# NAVAL POSTGRADUATE SCHOOL
# MONTEREY, CALIFORNIA

# THESIS

**RESISTANCE SCALING AND PREDICTIONS OF SLICE HULLS FROM MODEL TESTS**

by

Henry William Stevens III

September 1995

Thesis Advisor: Fotis A. Papoulias

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| REPORT DOCUMENTATION PAGE | Form Approved OMB No. 0704-0188 |
|---|---|



| 1. AGENCY USE ONLY *(Leave blank)* | 2. REPORT DATE<br>September 1995 | 3. REPORT TYPE AND DATES COVERED<br>Master's Thesis |
|---|---|---|

| | |
|---|---|
| 4. TITLE AND SUBTITLE RESISTANCE SCALING AND PREDICTIONS OF SLICE HULLS FROM MODEL TESTS. | 5. FUNDING NUMBERS |
| 6. AUTHOR(S): Henry William Stevens III | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br>Naval Postgraduate School<br>Monterey CA 93943-5000 | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER |

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

| 12a. DISTRIBUTION/AVAILABILITY STATEMENT<br>Approved for public release; distribution is unlimited. | 12b. DISTRIBUTION CODE |
|---|---|

13. ABSTRACT *(maximum 200 words)*

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| 14. SUBJECT TERMS SLICE, RESISTANCE, SCALING TECHNIQUES, SWATH | 15. NUMBER OF PAGES 130 |
|---|---|
| | 16. PRICE CODE |

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| Unclassified | Unclassified | Unclassified | UL |

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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# RESISTANCE SCALING AND PREDICTIONS OF SLICE HULLS FROM MODEL TESTS

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Submitted in partial fulfillment
of the requirements for the degree of

**MASTER OF SCIENCE IN MECHANICAL ENGINEERING**

from the

**NAVAL POSTGRADUATE SCHOOL**
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## ABSTRACT

This thesis evaluates several techniques for extrapolating full scale resistance of SLICE hulls from model test data. Using Froude's hypothesis, the ITTC and Hughes methods are employed to analyze single length and fragmented wetted surface area procedures. Finally, a hybrid procedure analyzing the struts as wing shapes and the pods as full hull forms is endeavored. It is shown that the classical Froude method severely overestimates the resistance of a SLICE hull. All approaches predict higher total resistances than Lockheed's own analysis, which is based on a variation of Hughes method. This thesis predicts that speeds of greater than thirty knots are achievable with the primary engine choice.

**TABLE OF CONTENTS**

**ACKNOWLEDGMENT**

I wish to thank my thesis advisor, Professor Fotis A. Papoulias, for his guidance and encouragement in this research.

I also express my extreme gratitude to my wife Catherine whose love, moral support, and personal sacrifices made completion of this work possible.

# I. INTRODUCTION

In the development of new vehicles, resistance minimization is a primary design focus since the propelling force must match this drag. In general, less resistance permits higher speeds and decreases fuel consumption for the same propulsion plant. Surface ships are exposed to two mediums: air and water. This thesis focuses on the subsurface resistances of the SLICE ATD (Advanced Technology Demonstration), shown in Figure 1.1.

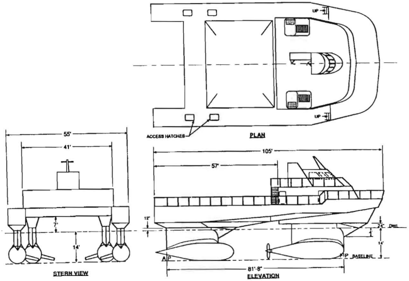


**Figure 1.1.** The SLICE configuration (Lockheed, 1994).

The SLICE concept was developed from the SWATH hull. A comparison of Figures 1.1 and 1.2 reveals the difference between the two hull forms. Essentially, the SLICE design cuts the middle section out of the SWATH's struts and pods.

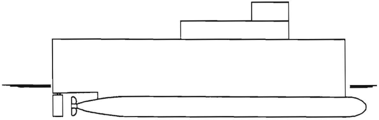

**Figure 1.2**. A typical SWATH vessel (Kennell, 1992).

Two accepted approaches used to extrapolate ship resistances from model data are the ITTC and Hughes methods (SNAME, 1988). These techniques break up a model resistance into subsidiary resistances and employ Reynolds and Froude scaling in different ways to predict ship resistance. Both procedures were performed on the SLICE model data.

A classical ITTC model to ship calculation was done using a single length approximation. This first guess was expected to overestimate the ship resistance since Kennell reported that the single length ITTC prediction overestimated SWATH resistances (Kennell, 1992). These results provided an upper limit by which other extrapolation techniques employed on the SLICE could be compared.

It was established that the resistance characteristics of a SWATH hull differ from those of a full displacement monohull (Kennell, 1992). The source of this difference was the relationship between the overall length and the wetted surface area. Figure 1.3 shows equal displacement ships and Kennell documents that SWATH ships have approximately sixty percent more wetted surface area than monohulls of the same displacement (Kennell, 1992). For the same reason, one would expect the resistance characteristics of a SLICE hull to differ from those of the monohull. The single length procedure uses equivalent flat plates of the prescribed length and area for resistance predictions. A monohull may be approximated in this manner but SWATH research indicates that separate evaluation of struts and pods yields predictions which more closely match actual ship data.

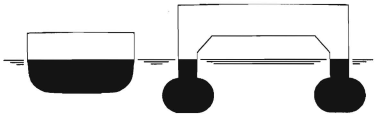

**Figure 1.3**. Comparison of an equal displacement monohull and SWATH (Kennell, 1992).

Using the ideas of Kennell, the SLICE wetted surface area was divided into strut and pod components (Kennell, 1992). The ITTC method was applied to extrapolate ship resistances and the Hughes method, which by definition, predicts smaller ship resistances was also applied to the sectioned hull.

Finally, a hybrid procedure analyzing the struts as wing shapes and the pods as full hull forms was developed. The hybrid examination results fell in between the ITTC and Hughes estimates.

The Lockheed Missile and Space Company, Inc. designed the SLICE and their analysis, also a variation of the Hughes method, predicted lower ship resistances than those presented here (Lockheed, 1994). Even though the drag is larger, this thesis, like Lockheed, anticipates that speeds of greater than thirty knots are achievable with the primary engine choice, depending on the overall propulsive efficiency.

## II. MODELING OVERVIEW

### A. FROUDE HYPOTHESIS

By Froude's hypothesis, the total resistance coefficient $C_T$ is a function of Reynolds Number $Rn$ and Froude Number $Fn$. Additionally, the total resistance coefficient may be divided into frictional and residual components. The frictional resistance coefficient $C_F$ is a function of Reynolds Number only while the residual resistance coefficient $C_R$ depends on both the Reynolds Number and Froude Number.

$$C_T(Rn,Fn) = C_F(Rn) + C_R(Rn,Fn) \tag{1}$$

A further subdivision of the residual resistance coefficient is possible by understanding that the wave making resistance coefficient $C_{WM}$ is included in the residual resistance coefficient. What remains of the residual resistance coefficient is the form drag coefficient $C_{FORM}$. The wave making resistance coefficient is a function of the Froude Number only and the form drag coefficient is constant for geometrically similar hulls.

$$C_R(Rn,Fn) = C_{WM}(Fn) + C_{FORM} \tag{2}$$

Therefore, the total resistance coefficient is given by the following equation.

$$C_T(Rn,Fn) = C_F(Rn) + C_{WM}(Fn) + C_{FORM} \quad (3)$$

A correlation allowance $C_A$ is added to the ship frictional and ship residual coefficients to give the ship total resistance coefficient. Figure 2.1 shows a general division of the model and ship resistance coefficients.

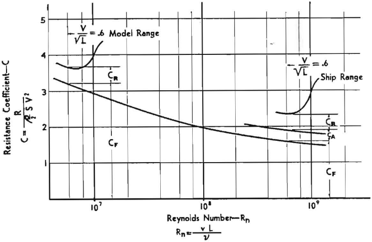


**Figure 2.1.** Model and ship resistance coefficients versus Reynolds Number (Gilmer and Johnson, 1982).

### B. ITTC METHOD

The ITTC Method follows Froude's hypothesis for the total resistance coefficient. It proposes an equation that produces a curve on the resistance coefficient $C_F$ versus Reynolds Number plot which represents the portion of the total coefficient due to friction as

$$C_F = \frac{0.075}{\left(\log_{10} Rn - 2\right)^2} \tag{4}$$

The ITTC method maintains the concept that the residual resistance coefficient is comprised of the wave making resistance and form drag components. The wave making resistance coefficient is dependent upon the Froude Number. For Froude scaling, the model and ship have the same Froude Numbers. Therefore, for a given Froude Number the model wave making resistance coefficient is equal to the ship wave making coefficient. Since the form drag coefficient is constant for geometrically similar vessels, the wave making and form drag coefficients can be analyzed at each Froude Number as a constant sum known as the residual resistance coefficient.

$$C_R\left(Rn, Fn\right) = C_{WM}\left(Fn\right) + C_{FORM} \tag{5}$$

In this way, an estimate of the ship total resistance coefficient may be derived from model test tank measurements. The component breakdown of the total resistance coefficient for the ITTC method is shown in Figure 2.2. In summary, the total resistance coefficient for the ITTC method is given by the following equation.

$$C_T\left(Rn, Fn\right) = C_F\left(Rn\right) + C_R\left(Rn, Fn\right) \tag{6}$$

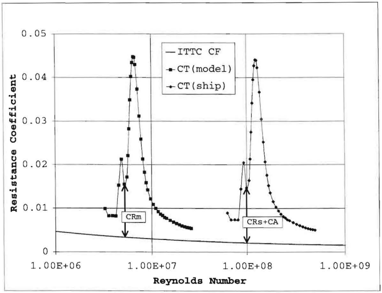


**Figure 2.2.** Total resistance coefficient versus Reynolds Number for an ITTC analysis.

## C. HUGHES METHOD

The Hughes method suggests a variation on Froude's hypothesis and modifies the friction coefficient curve. The analysis suggests that the frictional resistance and form drag are due to viscous effects and are therefore both a function of Reynolds Number. As plotted on Figure 2.3, the Hughes curve equation for the frictional resistance coefficient $C_{FO}$ is

$$C_{FO} = \frac{0.066}{\left(\log_{10} Rn - 2.03\right)^2} \tag{7}$$

The analysis proposes that the form drag coefficient can be related to the frictional resistance coefficient curve by some constant $\eta$.

$$C_{FORM}(Rn, Fn) = \eta \; C_{FO}(Rn) \tag{8}$$

By multiplying the frictional resistance coefficient by a form factor r, the form drag and frictional resistance components are combined into a single Reynolds dependent term. At low Froude Numbers the wave making resistance is negligible and therefore at a low speed the following holds:

$$C_T(Rn, Fn) = C_{FO}(Rn) + C_{FORM}(Rn) + \underbrace{C_{WM}(Fn)}_{0} \tag{9}$$

$$C_T(Rn, Fn) = (1+\eta) C_{FO}(Rn) \tag{10}$$

$$C_T(Rn, Fn) = r \; C_{FO}(Rn) \tag{11}$$

In this way, the form factor may be found for the hull shape. The form factor is constant for geometrically similar hulls. In general, the total resistance coefficient may be written in the form

$$C_T(Rn, Fn) = r \; C_{FO}(Rn) + C_{WM}(Fn) \tag{12}$$

The component breakdown of the total resistance coefficient is shown in Figure 2.3. The residual resistance coefficient for the Hughes method is a function of both the Reynolds Number and the Froude Number.

$$C_R(Rn, Fn) = C_{WM}(Fn) + C_{FORM}(Rn) \tag{13}$$

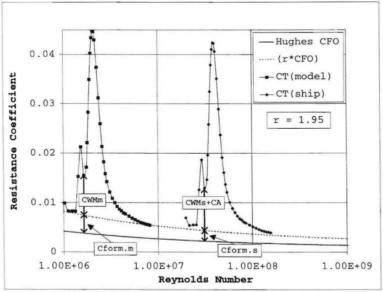


**Figure 2.3.** Total resistance coefficient versus Reynolds Number for the Hughes analysis.

## D. MODIFIED HUGHES METHOD

A further investigation was developed in which the struts were evaluated as wing sections. By this premise, one may consider the total drag attributed to the struts as equivalent to the drag of a geometrically similar wing shape. Using Figure 2.4, a wing drag coefficient $C_{d_{Wing}}$ was extracted.

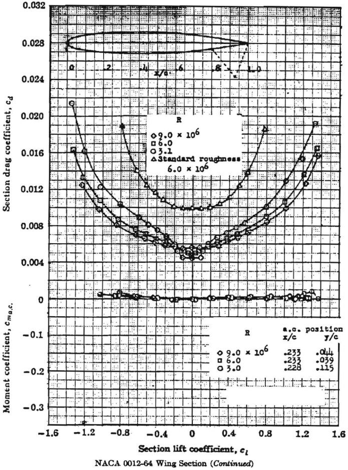


**Figure 2.4**. Section drag coefficient versus section lift coefficient for a NACA 0012-64 wing section (Abbott and von Doenhoff, 1959).

This wing drag coefficient however does not account for the effects of wave making resistance. Therefore, a wave making term must be added to account for its absence.

$$C_{T_{Strut}}(Rn, Fn) = C_{d_{Wing}}(Rn) + C_{WM_{Strut}}(Fn) \tag{14}$$

Applying the Froude analysis to the strut total resistance coefficient, the following may be written for the strut total drag coefficient.

$$C_{T_{Strut}}(Rn, Fn) = C_{FO_{Strut}}(Rn) + C_{WM_{Strut}}(Fn) + C_{FORM_{Strut}} \tag{15}$$

By assuming that at low Froude Numbers, in other words low speeds, the wave making resistance is negligible, the wing drag coefficient is equivalent to the strut total drag coefficient. This allows the strut form drag coefficient to be obtained by subtracting the strut frictional resistance coefficient from the strut total drag coefficient.

Because the wetted surface area was fragmented, the resistances, not the coefficients, were be used to arithmetically account for all effects. Once the portion of the form drag attributed to the struts was known, the pod form drag was calculated by subtracting the strut contribution from the overall form drag found in the Hughes analysis.

$$R_{FORM_{Pod}} = R_{FORM} - R_{FORM_{Strut}} \tag{16}$$

Due to the shape of the pods (oblong / aspect ratio) the form drag coefficient of the pods were considered functions of Reynolds Number and were therefore Reynolds scaled according to the Hughes method. The strut was approximated by a flat plat in turbulent flow with a constant form drag coefficient. Therefore, it is appropriate to separate the strut and pod form coefficients for the model to ship scaling process.

$$C_{FORM_{Pod}}(Rn,Fn) = \eta \; C_{FO_{Equiv}}(Rn) \tag{17}$$

$$C_{FORM_{Strut}} = const \tag{18}$$

The component breakdown of the total resistance coefficient is shown in Figure 2.5. Computationally, the separate resistance coefficients were found from their respective resistances in the following equation.

$$R_T(Rn,Fn) = R_{FO_{Equiv}}(Rn) + R_{FORM_{Pod}}(Rn) + R_{WM}(Fn) + R_{FORM_{Strut}} \tag{19}$$

The residual resistance coefficient for the Hughes method is a function of both the Reynolds Number and the Froude Number and was found from the summed residual resistance.

$$R_R(Rn,Fn) = R_{WM}(Fn) + R_{FORM_{Pod}}(Rn) + R_{FORM_{Strut}} \tag{20}$$

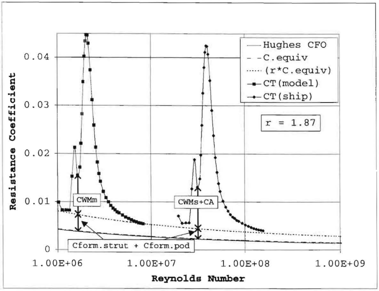


**Figure 2.5.** Total resistance coefficient versus Reynolds Number for the modified Hughes method.

In essence, the Hughes method has been modified such that the portion of the form drag attributed to the pods was reduced in the transfer from model to ship by Reynolds scaling while the strut portion was Froude scaled. An equivalent Hughes coefficient, found from $R_{Equiv}$, an equivalent resistance

$$R_{Equiv} = \left(R_{FO} + R_{FORM_{Strut}}\right) \tag{21}$$

was multiplied by the form factor $r$, to raise this equivalent Hughes curve to the desired value of the total resistance coefficient specified by the Hughes Method. Alternatively, the same form factor would be found by raising the original Hughes curve to a value equal to the total resistance coefficient minus an equivalent strut form drag coefficient.

# III. WETTED SURFACE AREA AND METHOD CALCULATIONS

## A. DETERMINATION OF THE WETTED SURFACE AREA

The wetted surface area of the SLICE hull was calculated from the Lockheed ship drawings P1-100-01 dated 13 December 1994. The waterline used was 14 feet (Lockheed, 1994). For calculation of the wetted surface area the hull was cut into numerous sections for easier analysis. Figures 3.1 through 3.4 show how the submerged hull was subdivided. Where separate calculated surface areas overlapped, appropriate area values were subtracted form the total.

### 1. Wetted Surface Area One

Wetted surface area One consisted of the forward angled piece delineated in Figure 3.1 and was calculated using triangular geometry. The calculations are provided in Appendix A. The vertical depths were taken from the ship drawings (Lockheed, 1994) and the horizontal distances from the strut centerline for each station were calculated by geometry. The shortened surface chord length from stations 0 to 3, due to the intersection with the wing part of the strut, was accounted for by decreasing the horizontal distance from the centerline. The angle between centerline and surface intersection with DWL was constant at 8.1 degrees. The Simpson Rule was used to calculate the wetted surface area of one side of one piece by connecting the surface chords. Therefore, the total wetted surface area of the two forward angled pieces was four times the calculated area of one side. To ensure accuracy, a trapezoidal rule calculation was also done.

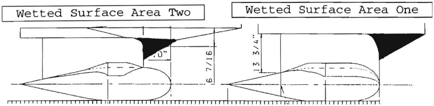


**Figure 3.1.** Wetted Surface Areas One and Two (Lockheed, 1994).

### 2. Wetted Surface Area Two

Wetted surface area Two consisted of the aft angled piece, delineated in Figure 3.1. The same procedure used to find area One was used to find area Two and the calculations are provided in Appendix A. Because the aft connections are different from the forward connections, the areas for the forward pods and the aft pods are distinct.

### 3. Wetted Surface Area Three

Area Three is the segment of the forward strut portion which is wing shaped as shown in Figure 3.2. It encompasses the surface from the DWL to the fillet which connects the strut to the pod. Depth measurements were taken off SHIP drawings (Lockheed, 1994) and the Simpson Rule was used to calculate surface area. To ensure accuracy, a trapezoidal rule calculation was also done. Calculations are provided in Appendix A.

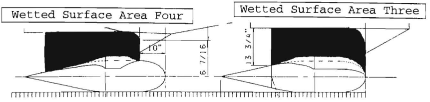


**Figure 3.2**. Wetted Surface Areas Three and Four (Lockheed, 1994).

### 4. Wetted Surface Area Four

Area Four is the segment of the aft strut portion which is wing shaped as shown in Figure 3.2. The same procedure used to find area Three was used to find area Four and the calculations are provided in Appendix A. Because the aft struts connect to the aft pods in a geometrically different way than the forward struts and pods, the fore and aft areas are different.

### 5. Wetted Surface Area Five

Area Five is the forward fillet, outlined in Figure 3.3 and consists of that part of the wetted surface which attaches the forward struts to the forward pods. The ship drawings (Lockheed, 1994) provided measurements to the upper and lower coordinates at ship stations. Surface chord lengths between these two points were calculated and the Simpson Rule was used to calculate the surface area. To ensure accuracy, a trapezoidal rule calculation was also done. The calculations are provided in Appendix A.

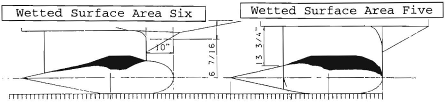


**Figure 3.3**. Wetted Surface Areas Five and Six (Lockheed, 1994).

### 6. Wetted Surface Area Six

Area Six is the aft fillet, outlined in Figure 3.3, corresponds to area Five of the forward hull. The surface was calculated the same way as the forward fillet but due to different for and aft connections, the areas for the forward segment and the aft segment are distinct. The calculations are provided in Appendix A.

### 7. Wetted Surface Area Seven

Wetted surface area Seven is the forward pod, outlined in Figure 3.4. Using cylindrical geometry, circumferences were calculated at each station. At stations where the pods connected to the struts and fillets, an appropriate arc lengths was subtracted from the circumference. The Simpson Rule was used to calculate surface area and a trapezoidal rule was done as a check. As expected the Trapezoidal rule supplied a smaller value since the nose section's surface is curved between stations rather than flat. The calculations are provided in Appendix A.

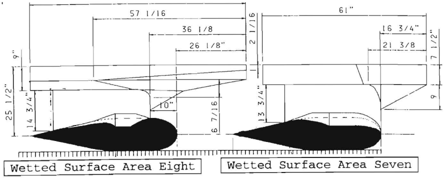


**Figure 3.4.** Wetted Surface Areas Seven and Eight (Lockheed, 1994).

### 8. Wetted Surface Area Eight

Figure 3.4 shows wetted surface area Eight which was calculated in the same manner as the forward pod. As before, the aft results differ form the forward ones because the aft connections are different from the forward connections. The calculations are provided in Appendix A.

## B. ITTC PROCEDURE ON A SINGLE LENGTH

The model velocities $V_M$ and model Froude Numbers $Fn_M$ were taken from the Lockheed test tank data. (Lockheed, 1994) The desired range of ship velocities $V_S$ was from 5 to 40 knots. By Froude scaling, the model Froude Number $Fn_M$ is equal to the ship Froude Number $Fn_S$ and with a scaling factor $\lambda$ equal to 8, the model velocities were set by the following relationship.

$$V_M = \frac{V_S}{\sqrt{\lambda}} \tag{22}$$

Lockheed ship drawings were used to establish a ship wetted surface area $S_S$ as described in the wetted surface area calculation chapter and the model wetted surface area $S_M$ was calculated by relating the ship wetted surface area and the scale factor λ appropriately.

$$S_M = \frac{S_S}{\lambda^2} \tag{23}$$

The model total drag $R_{T_M}$ provided by the Lockheed towing test, was the force required to move the model through the towing tank over the desired range of velocities. From the model total drag values, model total drag coefficients $C_{T_M}$ were found. The test tank fluid density $\rho_M$ was taken to be for fresh water at 68°F or 20°C.

$$\rho_M = \left(\frac{62.311}{32.174}\right)\frac{slugs}{ft^3} \tag{24}$$

$$C_{T_M} = \frac{R_{T_M}}{\left(\frac{1}{2}\rho_M S_M V_M^2\right)} \tag{25}$$

Equivalent model lengths $L_{M_{Equiv}}$ were calculated from the model Froude Numbers and model velocities where g is standard gravity. The twenty percent trim mean was taken as an average equivalent model length and used for all subsequent calculations.

$$g = 32.174 \frac{lb_m \cdot ft}{lb_f \cdot s^2} \tag{26}$$

$$L_{M_{Equiv}} = \frac{V_M^2}{gFn_M^2} \tag{27}$$

Reynolds Numbers were calculated based on the average equivalent model length and model velocities. These model Reynolds Numbers $Rn_M$ have no true relation to the actual geometry of the model, they are only representations of flow over a flat plate of equivalent frictional length. The test tank fluid kinematic viscosity $\nu_M$ was taken to be for fresh water at 68°F or 20°C.

$$\nu_M = 1.08042 \times 10^{-5} \frac{ft^2}{s} \tag{28}$$

$$Rn_M = \frac{V_M L_{M_{Equiv}}}{\nu_M} \tag{29}$$

Using the ITTC equation, a value for the overall model frictional coefficient $C_{F_M}$ was found and using this coefficient, a corresponding model frictional resistance $R_{F_M}$ was calculated.

$$C_{F_M} = \frac{0.075}{\left(\log_{10} Rn_M - 2\right)^2} \tag{30}$$

$$R_{F_M} = C_{F_M}\left(\tfrac{1}{2}\,\rho_M S_M V_M^2\right) \tag{31}$$

The model residual resistance coefficient $C_{R_M}$ is what remains of the model total resistance coefficient once the model frictional resistance coefficient is subtracted from it. The residual resistance is mostly due to wave making resistance and these were considered equivalent. Since the model wave making resistance coefficient is Froude scaled, it is equal to the ship wave making coefficient $C_{WM_S}$.

$$C_{R_M} = \left(C_{T_M} - C_{F_M}\right) = C_{WM_M} = C_{WM_S} \tag{32}$$

The model residual resistance $R_{R_M}$ , equivalent to the model wave making resistance $R_{WM_M}$ , was calculated from the model residual resistance coefficient.

$$R_{R_M} = C_{R_M}\left(\tfrac{1}{2}\,\rho_M S_M V_M^2\right) = R_{WM_M} \tag{33}$$

For the ship calculations, the ship velocities $V_S$ and an equivalent ship length $L_{S_{Equiv}}$ were calculated using Froude scale factor relationships. Again by Froude similarity, the ship Froude Number matches the model Froude Number for corresponding speeds.

$$V_S = \sqrt{\lambda}\,V_M \tag{34}$$

$$L_{S_{Equiv}} = \lambda\,L_{M_{Equiv}} \tag{35}$$

Using the ship velocities and the equivalent ship length, equivalent ship Reynolds Numbers $Rn_S$ were found and used to calculate ship frictional resistance coefficients $C_{F_S}$. A corresponding value of the ship frictional resistance $R_{F_S}$ was found. The test tank fluid kinematic viscosity $\nu_M$ and fluid density $\rho_M$ are for sea water at 59°F or 15°C. This is the standardized temperature for ship resistance calculations (SNAME, 1988).

$$\nu_S = 1.27908 \times 10^{-5} \frac{ft^2}{s} \tag{36}$$

$$\rho_S = \left(\frac{64.042}{32.174}\right)\frac{slugs}{ft^3} \tag{37}$$

$$Rn_S = \frac{V_S L_{S_{Equiv}}}{\nu_S} \tag{38}$$

$$C_{F_S} = \frac{0.075}{\left(\log_{10} Rn_S - 2\right)^2} \tag{39}$$

$$R_{F_S} = C_{F_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{40}$$

Since the SLICE hull is similar to the SWATH hull, a correlation allowance of 0.0005 was used. Based on research this value is most appropriate for SWATH vessels (Kennell, 1992). It is noted that Lockheed also used a correlation allowance of 0.0005 in their analysis (Lockheed, 1994). By Froude scaling, the ship wave making resistance coefficient $C_{WM_S}$ equals the model wave making resistance coefficient at corresponding velocities. Therefore, the ship total resistance coefficient $C_{T_S}$ was found and using this coefficient, a ship total resistance $R_{T_S}$ was resolved.

$$C_{T_S} = C_{F_S} + C_{WM_S} + C_A \tag{41}$$

$$R_{T_S} = C_{T_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{42}$$

The ship residual resistance coefficient was the remainder of the model total resistance coefficient once the ship frictional resistance and allowance coefficient were subtracted from it. As with the model, the residual resistance was analogous to the wave making resistance. A residual resistance was also calculated.

$$C_{R_S} = \left(C_{T_S} - C_{F_S} - C_A\right) = C_{WM_S} \tag{43}$$

$$R_{R_S} = C_{R_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{44}$$

## C. ITTC PROCEDURE ON A SECTIONALIZED HULL

The same values for model velocities $V_M$, model Froude Numbers $Fn_M$, scaling factor $\lambda$, model wetted surface area $S_M$, model total drag $R_{T_M}$, and model total drag coefficients $C_{T_M}$ were used. As in the previous analysis, the test tank fluid density $\rho_M$ and fluid kinematic viscosity $\nu_M$ were taken to be for fresh water at 68°F or 20°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and the proportional model lengths $L_M$ were found. Then, Reynolds Numbers were calculated for each of the model sections. These model Reynolds Numbers $Rn_M$ represent values for flow over a flat plate of equivalent frictional length.

$$Rn_M = \frac{V_M L_M}{\nu_M} \tag{45}$$

Using the ITTC equation, a value for the section's model frictional coefficient $C_{F_M}$ was found.

$$C_{F_M} = \frac{0.075}{\left(\log_{10} Rn_M - 2\right)^2} \tag{46}$$

From the ITTC model frictional coefficients, corresponding model frictional resistances $R_{F_M}$ were calculated for each section and then summed together to form an overall model frictional resistance.

$$R_{F_M} = C_{F_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) \tag{47}$$

$$R_{F_M} = \sum_{i=1}^{n} R_{F_{M_i}} \qquad n = number\ of\ sections \tag{48}$$

Once an overall frictional resistance was found, an equivalent frictional resistance coefficient $C_{F_{M_{Equiv}}}$ was found and from that an equivalent Reynolds Number $Rn_{M_{Equiv}}$ and equivalent length $L_{M_{Equiv}}$ were calculated.

$$C_{F_{M_{Equiv}}} = \frac{R_{F_M}}{\left(\frac{1}{2}\rho_M S_M V_M^2\right)} \tag{49}$$

$$Rn_{M_{Equiv}} = 10^{\left(2+\sqrt{\frac{0.075}{C_{F_{M_{Equiv}}}}}\right)} \tag{50}$$

$$L_{M_{Equiv}} = \frac{Rn_{M_{Equiv}} \nu_M}{V_M} \tag{51}$$

The model residual resistance coefficient $C_{R_M}$ is what remains of the model total resistance coefficient once the model frictional resistance coefficient is subtracted from it. The residual resistance is mostly due to wave making resistance and these were considered equivalent. Since the model wave making resistance coefficient $C_{WM_M}$ is Froude scaled, it is equal to the ship wave making coefficient $C_{WM_S}$.

$$C_{R_M} = \left(C_{T_M} - C_{F_M}\right) = C_{WM_M} = C_{WM_M} \tag{52}$$

The model residual resistance $R_{R_M}$, equivalent to the model wave making resistance $R_{WM_M}$, was calculated from the model residual resistance coefficient.

$$R_{R_M} = C_{R_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) = R_{WM_M} \tag{53}$$

The same ship velocities $V_S$, ship Froude Numbers $Fn_S$ and ship wetted surface area $S_S$ for the ITTC method were used in these calculations. As before, the ship fluid density $\rho_S$ and fluid kinematic viscosity $\nu_S$ were taken to be for sea water at 59°F or 15°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and used to calculate Reynolds Numbers. These ship Reynolds Numbers $Rn_S$ represent values for flow over a flat plate of equivalent frictional length.

$$Rn_S = \frac{V_S L_S}{\nu_S} \tag{54}$$

Using the ITTC equation, a value for the ship section's frictional coefficient $C_{F_S}$ was found.

$$C_{F_S} = \frac{0.075}{\left(\log_{10} Rn_S - 2\right)^2} \tag{55}$$

From the ship section's ITTC frictional coefficients, corresponding ship frictional resistances $R_{F_S}$ were calculated for each section and these were summed together to form an overall ship frictional resistance.

$$R_{F_S} = C_{F_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{56}$$

$$R_{F_S} = \sum_{i=1}^{n} R_{F_{S_i}} \qquad n = number\ of\ sections \tag{57}$$

Once an overall frictional resistance was found, an equivalent ship frictional resistance coefficient $C_{F_{S_{Equiv}}}$ was found and from that an equivalent ship Reynolds Number $Rn_{S_{Equiv}}$ and equivalent ship length $L_{S_{Equiv}}$ were calculated.

$$C_{F_{S_{Equiv}}} = \frac{R_{F_S}}{\left(\frac{1}{2}\rho_S S_S V_S^2\right)} \tag{58}$$

$$Rn_{S_{Equiv}} = 10^{\left(2+\sqrt{\frac{0.075}{C_{F_{S_{Equiv}}}}}\right)} \tag{59}$$

$$L_{S_{Equiv}} = \frac{Rn_{S_{Equiv}} \nu_S}{V_S} \tag{60}$$

The correlation allowance $C_A$ was taken to be 0.0005, and the ship wave making resistance coefficient $C_{WM_S}$ was taken to be equal to the model wave making resistance coefficient at corresponding velocities. Therefore, the ship total resistance coefficient $C_{T_S}$ was found and using this coefficient, a ship total resistance $R_{T_S}$ was resolved.

$$C_{T_S} = C_{F_{S_{Equiv}}} + C_{WM_S} + C_A \tag{61}$$

$$R_{T_S} = C_{T_S}\left(\frac{1}{2}\rho_S S_S V_S^2\right) \tag{62}$$

The ship residual resistance coefficient was the remainder of the model total resistance coefficient once the ship frictional resistance and allowance coefficients were subtracted from it. As with the model, the residual resistance was analogous to the wave making resistance. A residual resistance was also calculated.

$$C_{R_S} = \left(C_{T_S} - C_{F_S} - C_A\right) = C_{WM_S} \tag{63}$$

$$R_{R_S} = C_{R_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{64}$$

## D. HUGHES PROCEDURE ON A SECTIONALIZED HULL

The values for model velocities $V_M$, model Froude Numbers $Fn_M$, scaling factor $\lambda$, model wetted surface area $S_M$, model total drag $R_{T_M}$, and model total drag coefficients $C_{T_M}$ were the same as in previous analyses. Again, the test tank fluid density $\rho_M$ and fluid kinematic viscosity $\nu_M$ were taken to be for fresh water at 68°F or 20°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and the proportional model lengths $L_M$ were found. Then, Reynolds Numbers were calculated for each model section. These model Reynolds Numbers $Rn_M$ represent values for flow over a flat plate of equivalent frictional length.

$$Rn_M = \frac{V_M L_M}{\nu_M} \tag{65}$$

Using the Hughes equation, a value for each section's model frictional coefficient $C_{FO_M}$ was found.

$$C_{FO_M} = \frac{0.066}{\left(\log_{10} Rn_M - 2.03\right)^2} \tag{66}$$

From the Hughes model frictional coefficients, corresponding model frictional resistances $R_{FO_M}$ were calculated for each section and then summed together to form an overall model frictional resistance.

$$R_{FO_M} = C_{FO_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) \tag{67}$$

$$R_{FO_M} = \sum_{i=1}^{n} R_{FO_{M_i}} \qquad n = number\ of\ sections \tag{68}$$

Once an overall frictional resistance was found, an equivalent model frictional resistance coefficient $C_{FO_{M_{Equiv}}}$ was found and from that an equivalent model Reynolds Number $Rn_{M_{Equiv}}$ and equivalent model length $L_{M_{Equiv}}$ were calculated.

$$C_{FO_{M_{Equiv}}} = \frac{R_{FO_M}}{\left(\tfrac{1}{2}\rho_M S_M V_M^2\right)} \tag{69}$$

$$Rn_{M_{Equiv}} = 10^{\left(2.03+\sqrt{\frac{0.066}{C_{FOM_{Equiv}}}}\right)} \tag{70}$$

$$L_{M_{Equiv}} = \frac{Rn_{M_{Equiv}} \nu_M}{V_M} \tag{71}$$

As explained in Chapter II, the form factor r was found by raising the Hughes curve up to the model total resistace coefficient at a low speed. Figure 2.3 shows the new curve which is the product of multiplying the form factor and the Hughes equivalent resistance coefficients The new curve is the sum of the model equivalent frictional resistance coefficient and the model form drag coefficient. From this, the model form drag coefficient $C_{FORM_M}$ and the model form drag $R_{FORM_M}$ were found.

$$C_{FORM_M} = C_{FO_M}(r-1) \tag{72}$$

$$R_{FORM_M} = C_{FORM_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) \tag{73}$$

The model wave making $C_{WM_M}$ is what remains of the model total resistance coefficient once the model frictional resistance coefficient and model form drag coefficient are subtracted from it. Since the model wave making resistance coefficient is Froude scaled, it is equal to the ship wave making coefficient $C_{WM_S}$.

$$C_{WM_M} = \left(C_{T_M} - C_{FO_M} - C_{FORM_M}\right) = \left(C_{T_M} - r\, C_{FO_M}\right) = C_{WM_S} \tag{74}$$

The model residual resistance $R_{R_M}$, equivalent to the model wave making resistance $R_{WM_M}$, was calculated from the model residual resistance coefficient by the relation:

$$R_{R_M} = C_{R_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) = R_{WM_M} \tag{75}$$

The same ship velocities $V_S$, ship Froude Numbers $Fn_S$ and ship wetted surface area $S_S$ for the ITTC method were used in these calculations. As before, the ship fluid density $\rho_S$ and fluid kinematic viscosity $\nu_S$ were taken to be for sea water at 59°F or 15°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and used to calculate Reynolds Numbers. These ship Reynolds Numbers $Rn_S$ represent values for flow over a flat plate of equivalent frictional length.

$$Rn_S = \frac{V_S L_S}{\nu_S} \tag{76}$$

Using the Hughes equation, a value for the ship frictional coefficient $C_{FO_S}$ was found for each section.

$$C_{FO_S} = \frac{0.066}{\left(\log_{10} Rn_S - 2.03\right)^2} \tag{77}$$

From the ship Hughes frictional coefficients, corresponding ship frictional resistances $R_{FO_S}$ were calculated for each section and then summed together to form an overall ship frictional resistance.

$$R_{FO_S} = C_{FO_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{78}$$

$$R_{FO_S} = \sum_{i=1}^{n} R_{FO_{S_i}} \qquad n = number\ of\ sections \tag{79}$$

Once an overall frictional resistance was found, an equivalent ship frictional resistance coefficient $C_{FO_{S_{Equiv}}}$ was found and from that an equivalent ship Reynolds Number $Rn_{S_{Equiv}}$ and equivalent ship length $L_{S_{Equiv}}$ were calculated.

$$C_{FO_{S_{Equiv}}} = \frac{R_{FO_S}}{\left(\tfrac{1}{2}\rho_S S_S V_S^2\right)} \tag{80}$$

$$Rn_{S_{Equiv}} = 10^{\left(2+\sqrt{\frac{0.075}{C_{FO_{S_{Equiv}}}}}\right)} \tag{81}$$

$$L_{S_{Equiv}} = \frac{Rn_{S_{Equiv}}\,\nu_S}{V_S} \tag{82}$$

Multiplying the ship equivalent frictional resistance coefficients by the established form factor r yields a new curve which is the sum of the ship equivalent frictional resistance coefficient and the ship form drag coefficient. Therefore the ship form drag coefficient $C_{FORM_S}$ and the ship form drag $R_{FORM_S}$ can be found.

$$C_{FORM_S} = C_{FO_S}(r-1) \tag{83}$$

$$R_{FORM_S} = C_{FORM_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{84}$$

The correlation allowance $C_A$ was taken to be 0.0005, and the ship wave making resistance coefficient $C_{WM_S}$ was taken to be equal to the model wave making resistance coefficient at corresponding velocities. Therefore, the ship total resistance coefficient $C_{T_S}$ was found and using this coefficient, a ship total resistance $R_{T_S}$ was resolved.

$$C_{T_S} = \left(C_{FO_{S_{Equiv}}} + C_{FORM_S} + C_{WM_S} + C_A\right) \tag{85}$$

$$R_{T_S} = C_{T_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{86}$$

The ship residual resistance coefficient $C_{R_S}$ was the remainder of the model total resistance coefficient once the ship frictional resistance and allowance coefficients were subtracted from it. The residual resistance $R_{R_S}$ includes the wave making effects and the form drag.

$$C_{R_S} = \left(C_{T_S} - C_{FO_S} - C_A\right) = \left(C_{WM_S} + C_{FORM_S}\right) \tag{87}$$

$$R_{R_S} = C_{R_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{88}$$

## E. MODIFIED HUGHES PROCEDURE ON A SECTIONALIZED HULL

For this analysis, the values for model velocities $V_M$, model Froude Numbers $Fn_M$, scaling factor $\lambda$, model wetted surface area $S_M$, model total drag $R_{T_M}$, and model total drag coefficients $C_{T_M}$ were the same as used in the previous analyses. Again, the test tank fluid density $\rho_M$ and fluid kinematic viscosity $\nu_M$ were taken to be for fresh water at 68°F or 20°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and the proportional model lengths $L_M$ were found. Then, Reynolds Numbers were calculated for each model section. These model Reynolds Numbers $Rn_M$ represent values for flow over a flat plate of equivalent frictional length.

$$Rn_M = \frac{V_M L_M}{\nu_M} \tag{89}$$

Using the Hughes equation, a value for each section's model frictional coefficient $C_{FO_M}$ was found.

$$C_{FO_M} = \frac{0.066}{\left(\log_{10} Rn_M - 2.03\right)^2} \tag{90}$$

From the Hughes model frictional coefficients, corresponding model frictional resistances $R_{FO_M}$ were calculated for each section and then summed together to form an overall model frictional resistance.

$$R_{FO_M} = C_{FO_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) \tag{91}$$

$$R_{FO_M} = \sum_{i=1}^{n} R_{FO_{M_i}} \qquad n = number\ of\ sections \tag{92}$$

Once an overall frictional resistance was found, an equivalent model frictional resistance coefficient $C_{FO_{M_{Equiv}}}$ was found and from that an equivalent model Reynolds Number $Rn_{M_{Equiv}}$ and equivalent model length $L_{M_{Equiv}}$ were calculated.

$$C_{FO_{M_{Equiv}}} = \frac{R_{FO_M}}{\left(\tfrac{1}{2}\rho_M S_M V_M^2\right)} \tag{93}$$

$$Rn_{M_{Equiv}} = 10^{\left(2.03 + \sqrt{\frac{0.066}{C_{FO_{M_{Equiv}}}}}\right)} \tag{94}$$

$$L_{M_{Equiv}} = \frac{Rn_{M_{Equiv}} \nu_M}{V_M} \tag{95}$$

Here is the modification to the Hughes Method. Rather than consider it as a single term, the form drag was further subdivided into strut and pod components. By doing this, results from a separate analysis of the strut were incorporated into the model research. In particular, the struts were investigated as wing shapes whose *form drag* coefficient was a constant.

The wing chosen which most closely resembled the struts was NACA 0012-64. Using Figure 3.3, a wing drag coefficient $C_{d_{Wing}} = 0.0044$ was extracted. The wave making resistance of the strut was taken to be negligible at a low Froude Number. The Froude Number chosen was where the model total resistance coefficient was minimum at low speeds. For a Froude Number of $Fn = 0.2$, the model strut frictional resistance coefficient was $C_{FO_{Strut_M}} = 0.004120136$ and this was subtracted from the wing drag coefficient to determine the strut form drag coefficient $C_{FORM_{Strut}}$.

$$C_{Form_{Strut}} = C_{d_{Wing}} - C_{FO_{Strut_M}} = 0.000279864 \qquad (96)$$

The model strut form drag $R_{FORM_{Strut_M}}$ was found using the model strut wetted surface area $S_{Strut_M}$. The strut surface area was taken as the sum of wetted surface areas One, Two, Three, Four, Five, and Six.

$$R_{FORM_{Strut_M}} = C_{FORM_{Strut}}\left(\tfrac{1}{2}\rho_M S_{Strut_M} V_M^2\right) \qquad (97)$$

Then the model frictional resistance and the model strut form drag were added together to find a single equivalent coefficient $C_{Equiv_M}$ which could then be multiplied by the form factor r to raise the Hughes curve to the model total at low Froude Numbers.

$$C_{Equiv_M} = \frac{\left(R_{FO_M} + R_{FORM_{Strut_M}}\right)}{\left(\tfrac{1}{2}\rho_M S_M V_M^2\right)} \qquad (98)$$

$$R_{Equiv_M} = C_{Equiv_M}\left(\tfrac{1}{2}\rho_M S_M V_M^2\right) \tag{99}$$

The difference between the value multiplied by the form factor and the premultiplied value was set equal to the model pod form drag $R_{Form_{Pod_M}}$. The corresponding model pod from drag coefficient $C_{FORM_{Pod_M}}$ was calculated using the model pod wetted surface area $S_{Pod_M}$. The pod wetted surface area was taken as the sum of wetted surface areas Seven and Eight.

$$R_{Form_{Pod_M}} = (r-1)\, R_{Equiv_M} \tag{100}$$

$$C_{FORM_{Pod_M}} = \frac{R_{FORM_{Pod_M}}}{\left(\tfrac{1}{2}\rho_M S_{Pod_M} V_M^2\right)} \tag{101}$$

The total model form drag was the strut form drag plus the pod form drag and using the entire model wetted surface area a model form drag coefficient was calculated.

$$R_{FORM_M} = R_{FORM_{Strut_M}} + R_{FORM_{Pod_M}} \tag{102}$$

$$C_{FORM_M} = \frac{R_{FORM_M}}{\left(\tfrac{1}{2}\rho_M S_M V_M^2\right)} \tag{103}$$

The model wave making $C_{WM_M}$ was found by subtracting the model frictional resistance coefficient and model form drag coefficient from the model total resistance coefficient. Since the model wave making resistance coefficient is Froude scaled, it is equal to the ship wave making coefficient $C_{WM_S}$ at comparable speeds. Additionally, the model wave making resistance $R_{WM_M}$, was calculated.

$$C_{WM_M} = \left( C_{T_M} - C_{FO_{M_{Equiv}}} - C_{FORM_M} \right) = C_{WM_S} \tag{104}$$

$$R_{WM_M} = C_{WM_M} \left( \tfrac{1}{2} \rho_M S_M V_M^2 \right) \tag{105}$$

The model residual resistance coefficient $C_{R_M}$ is what remains of the model total resistance coefficient once the equivalent model frictional resistance coefficient is subtracted from it. The model residual resistance $R_{R_M}$ includes the wave making resistance and the form drag.

$$C_{R_M} = \left( C_{T_M} - C_{FO_{M_{Equiv}}} \right) = \left( C_{WM_M} + C_{FORM_M} \right) \tag{106}$$

$$R_{R_M} = C_{R_M} \left( \tfrac{1}{2} \rho_M S_M V_M^2 \right) \tag{107}$$

The same ship velocities $V_S$, ship Froude Numbers $Fn_S$ and ship wetted surface area $S_S$ for the ITTC method were used in these calculations. As before, the ship fluid density $\rho_S$ and fluid kinematic viscosity $\nu_S$ were taken to be for sea water at 59°F or 15°C.

Ship lengths $L_S$ for each pod and strut section were taken from the ship drawings (Lockheed, 1994) and used to calculate Reynolds Numbers. These ship Reynolds Numbers $Rn_S$

represent values for flow over a flat plate of equivalent frictional length.

$$Rn_S = \frac{V_S L_S}{\nu_S} \tag{108}$$

Using the Hughes equation, a value for the ship frictional coefficient $C_{FO_S}$ was found for each section.

$$C_{FO_S} = \frac{0.066}{\left(\log_{10} Rn_S - 2.03\right)^2} \tag{109}$$

From the ship Hughes frictional coefficients, corresponding ship frictional resistances $R_{FO_S}$ were calculated for each section and then summed together to form an overall ship frictional resistance.

$$R_{FO_S} = C_{FO_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{110}$$

$$R_{FO_S} = \sum_{i=1}^{n} R_{FO_{S_i}} \qquad n = number\ of\ sections \tag{111}$$

Once an overall frictional resistance was found, an equivalent ship frictional resistance coefficient $C_{FO_{S_{Equiv}}}$ was found and from that an equivalent ship Reynolds Number $Rn_{S_{Equiv}}$ and equivalent ship length $L_{S_{Equiv}}$ were calculated.

$$C_{FO_{S_{Equiv}}} = \frac{R_{FO_S}}{\left(\tfrac{1}{2}\rho_S S_S V_S^2\right)} \tag{112}$$

$$Rn_{S_{Equiv}} = 10^{\left(2+\sqrt{\frac{0.075}{C_{FOS_{Equiv}}}}\right)} \tag{113}$$

$$L_{S_{Equiv}} = \frac{Rn_{S_{Equiv}} \nu_S}{V_S} \tag{114}$$

Since the strut form drag coefficient $C_{FORM_{Strut}}$ was taken as constant, the ship strut form drag $R_{FORM_{Strut_S}}$ was found using the ship strut wetted surface area $S_{Strut_S}$.

$$R_{FORM_{Strut_S}} = C_{FORM_{Strut}}\left(\tfrac{1}{2}\rho_S S_{Strut_S} V_S^2\right) \tag{115}$$

Then the ship frictional resistance and the ship strut form drag were added together to find a single equivalent coefficient $C_{Equiv_S}$ which was multiplied by the form factor r to raise the Hughes curve.

$$C_{Equiv_S} = \frac{\left(R_{FO_S} + R_{FORM_{Strut_S}}\right)}{\left(\tfrac{1}{2}\rho_S S_S V_S^2\right)} \tag{116}$$

$$R_{Equiv_S} = C_{Equiv_S}\left(\tfrac{1}{2}\rho_S S_S V_S^2\right) \tag{117}$$

The difference between the value multiplied by the form factor and the premultiplied value was set equal to the ship pod form drag $R_{Form_{Pod_S}}$. The corresponding ship pod from drag coefficient $C_{FORM_{Pod_S}}$ was calculated using the ship pod wetted surface area $S_{Pod_S}$.

$$R_{Form_{Pod_S}} = (r-1)\,R_{Equiv_S} \tag{118}$$

$$C_{FORM_{Pod_S}} = \frac{R_{FORM_{Pod_S}}}{\left(\frac{1}{2}\,\rho_S S_{Pod_S} V_S^2\right)} \tag{119}$$

The total ship form drag $R_{FORM_S}$ was the strut form drag plus the pod form drag and using the entire ship wetted surface area, a ship form drag coefficient $C_{FORM_S}$ was found.

$$R_{FORM_S} = R_{FORM_{Strut_S}} + R_{FORM_{Pod_S}} \tag{120}$$

$$C_{FORM_S} = \frac{R_{FORM_S}}{\left(\frac{1}{2}\,\rho_S S_S V_S^2\right)} \tag{121}$$

Since the wave making resistance coefficient is Froude scaled, the ship wave making resistance coefficient $C_{WM_S}$ is equal to the model wave making coefficient $C_{WM_M}$. The corresponding ship wave making resistance $R_{WM_S}$, was then quantified.

$$C_{WM_S} = C_{WM_M} \tag{122}$$

$$R_{WM_S} = C_{WM_S}\left(\frac{1}{2}\,\rho_S S_S V_S^2\right) \tag{123}$$

With a correlation allowance $C_A$ of 0.0005, the ship total resistance coefficient $C_{T_S}$ was found and using this coefficient, the ship total resistance $R_{T_S}$ was resolved.

$$C_{T_S} = \left( C_{FO_{S_{Equiv}}} + C_{FORM_S} + C_{WM_S} + C_A \right) \tag{124}$$

$$R_{T_S} = C_{T_S} \left( \tfrac{1}{2} \rho_S S_S V_S^2 \right) \tag{125}$$

The ship residual resistance coefficient $C_{R_S}$ was the remainder of the model total resistance coefficient once the ship frictional resistance and allowance coefficients were subtracted from it. The residual resistance $R_{R_S}$ includes the wave making effects and the form drag.

$$C_{R_S} = \left( C_{T_S} - C_{FO_{S_{Equiv}}} - C_A \right) = \left( C_{WM_S} + C_{FORM_S} \right) \tag{126}$$

$$R_{R_S} = C_{R_S} \left( \tfrac{1}{2} \rho_S S_S V_S^2 \right) \tag{127}$$

# IV. DISCUSSION OF RESULTS

## A. METHOD RESULTS

### 1. ITTC Single Length Analysis

As previously explained, the ITTC single length analysis, provided in Appendix B, used the Lockheed Froude Numbers to set the model length. Figure 4.1 shows the test tank model drag divided into frictional and residual components. The frictional portion, steadily increases with velocity and the residual resistance is just the difference between the total and frictional resistances. The frictional resistance was Reynolds scaled to predict the ship quantity. Since the ITTC method follows the classical Froude resistance procedure, the residual resistance was not divided into form and wave making components. The entire residual element was Froude scaled to estimate the ship residual component. Figure 4.2 shows the result of combining the ship frictional and ship residual resistances.

For both the model and ship calculations the major component of the total was the residual resistance. This suggested a need to more closely examine the Froude scaled resistances of the SLICE.

The most noticeable characteristic of Figures 4.1 and 4.2 are the two humps. These humps can be related to similar findings with SWATH hulls. Plots of residual resistance coefficients versus Froude Number of SWATH vessels exhibit prismatic humps followed by primary humps (Kennell, 1992). Figure 4.3 shows such a plot for a SWATH vessel and Figures 4.4 and 4.5 show similar plots for the SLICE model and ship. Whereas the prismatic hump for a SWATH vessel is generally found near a Froude Number of 0.3, the prismatic hump for the SLICE is shifted left to a Froude Number of 0.23. Similarly, the primary hump of a SWATH is found near a Froude Number of 0.5 while the hump appears at 0.31 for the SLICE. These figures show that the residual resistance is the major component of the total in mid-range speeds.

### 2. ITTC Sectionalized Hull Analysis

The ITTC sectionalized hull analysis is provided in Appendix B. By sectioning the hull, the portion of the test tank model drag associated with friction was increased. Thus, a larger part of the total resistance was dependent on the Reynolds Number and a smaller part was dependent on the Froude Number. Although an equivalent Froude Number based on the equivalent length could be found, the Froude Number used was the same as in the single length calculations. As Figure 4.6 shows, at high speeds the model's frictional percentage was greater than the residual percentage. In the previous analysis, the residual resistance percentage was always greater than the frictional quantity. The result of altering the relative Reynolds and Froude Number dependence in this way was a decrease in predicted ship total resistance, most noticeably at higher speeds.

Although the model's frictional resistance was greater than the residual portion at high speeds, Figure 4.7 shows the same was not true for the ship. This occurs because when predicting ship quantities, the Froude scaled resistances increase more than the Reynolds scaled ones.

Figures 4.8 and 4.9 show that the prismatic and primary humps are located at the same Froude Numbers as in the previous analysis and there is no sign of an additional hump at higher Froude Numbers. The model friction-residual switch which was shown in Figure 4.6 appears in Figure 4.8 at the corresponding Froude Number. As in Figure 4.7, Figure 4.9 shows that there is not a switch once the quantities have been expanded to the ship. As before, the residual resistance coefficient continues to taper off after the primary hump. And, as in the first case, the residual was the primary source of resistance throughout the speed range of the ship.

### 3. Hughes Sectionalized Hull Analysis

It was decided to more closely examine the Froude scaled resistances of the SLICE hull. Trying a different approach, the Hughes method was chosen because it further breaks down the residual resistance into form and wave making components. From previous discussion, it was shown that the form drag could be Reynolds scaled and the wave making Froude scaled. The Hughes sectionalizeded hull analysis is provided in Appendix B.

Integral to the Hughes method is the idea that at low Froude Numbers, the wave making resistance is negligible. In fact, this idea was used to find the form factor. Figures 4.10 and 4.11 show the frictional and residual breakdown for this approach. In order to compare this analysis with the ITTC methods, it was necessary to show the resistance division as a function of the Reynolds and Froude Numbers. Figures 4.12 and 4.13 show the dramatic shift in relative Froude and Reynolds Number dependencies of the Hughes approach. Very apparent is that at high speeds the total drag is almost entirely due to Reynolds dependent resistances whereas for the ITTC cases, the Froude scaled component was dominant.

Figures 4.14 through 4.17 show the plots of resistance coefficients vs. Froude Number for this method. As in the ITTC analyses, once the Froude Number is greater than 0.3, the residual and total coefficients taper off and there is no sign of another hump or increase.

Figures 4.18 and 4.19 show the model division and ship predicted composition of the residual resistance. From the above investigation, an important concept of the procedure was revealed. This method predicts very little wave making resistance at high speeds for the SLICE hull. Note that the Froude scaled resistance equals the wave making resistance. The residual resistance of the sectionalized Hughes analysis is almost entirely from the form drag. A video of the model in the test tank supports the concept of small wave generation at high speeds.

#### 4. Modified Hughes Sectionalized Hull Analysis

Recall that for Froude's hypothesis and the ITTC scaling procedure, the form drag component was Froude scaled, i.e., constant for each Froude Number. But, in the Hughes analysis, all of the form drag was Reynolds scaled. Since it played such an important role in the Hughes method, a further subdivision of the form drag was undertaken such that the pod portion was Reynolds scaled and the strut portion was Froude scaled. The modified Hughes sectionalized hull analysis is provided in Appendix B.

Figures 4.20 through 4.23 show the frictional and residual breakdown for the hybrid procedure. In order to compare this analysis with the ITTC methods, the resistance was divided into parts which were functions of the Reynolds and Froude Numbers. Figures 4.24 through 4.27 show that this alteration only slightly shifts the relative Reynolds and Froude Number dependencies back toward the ITTC ratios. Figures 4.28 and 4.29 can be compared to Figures 4.18 and 4.19 of the Hughes method for the purpose of showing the results of varying the residual resistance dependency.

Because of the shift toward Froude scaling, the predicted ship total resistance for this method was slightly higher than the sectionalized Hughes method. It was still considerably lower than both the ITTC analyses.

## B. COMPARISON OF METHOD RESULTS

### 1. Frictional Resistance Comparison

Figure 4.30 compares the model frictional resistance components of the various methods. The single length method's percentage of the model total resistance was less than the sectioned hull methods. The Hughes and modified Hughes methods used the same frictional resistance values. Figure 4.30 also includes the Lockheed skin friction which was greater than classical ITTC and Hughes assessments. By definition, the Hughes equation yields lower frictional resistance coefficients than the ITTC equation and the two sectioned hull resistance curves of Figure 4.30 show that. Figure 4.31 shows the ship frictional resistances and the Lockheed ship skin friction. Because they were all Reynolds scaled, the ship frictional resistance curves follow the same trend as the model curves.

### 2. Residual Resistance Comparison

Figure 4.32 compares the model residual resistances for the various procedures. Also plotted was the Lockheed residual which taken as equal to the Lockheed sum minus the Lockheed skin friction. The single length method gave a larger percentage of the total to the residual resistance compared to the sectioned hull approaches. Note that the Hughes and modified Hughes methods have the same model residual resistances.

Figure 4.33 shows the predicted ship residual resistances for the procedures. The residual resistance was Froude scaled in the ITTC methods but was Reynolds scaled in the Hughes method. The modified Hughes method combined both Reynolds and Froude scaling to predict the ship residual resistance. The figure shows that Froude scaling resulted in higher predicted ship quantities when compared to equivalent Reynolds scaling. Since the modified Hughes method was a combination of the two scaling procedures, the predicted values fell in between the ITTC and Hughes estimates.

Figure 4.34 compares the division of the model residual resistance for the Hughes and modified Hughes methods. Both methods started with the same model total residual resistance and had the essentially the same wave making and form drag components. Because the form factors were only taken to two decimal points, slight differences on the order of less than a pound do exist between the two method's component values. Since the model figure is only a synopsis of the data, Figure 4.34 only shows one curve for each of these resistance constituents. The modified Hughes method division of strut and pod form drags were also plotted.

Figure 4.35 shows the division of the predicted ship residual resistances for the Hughes and modified Hughes methods. The figure shows that the modified Hughes method predicted higher overall ship residual resistances. The ship wave making resistances for both methods was the same since it was Froude scaled in both instances. Although not explicitly calculated, the predicted ship pod drag of the Hughes method matched the modified Hughes value since it was Reynolds scaled in both methods. Therefore, the source of the increased predicted ship residual resistance was the strut form drag. It was identified that Froude scaling resulted in higher predicted ship values when compared to Reynolds scaling. Since the strut form drag was Froude scaled in the modified Hughes Method, its value was greater than the Hughes method Reynolds scaled counterpart.

From this investigation, one can see that for the modified Hughes method, any variation of the wetted surface area division would result in a ship residual resistance somewhere between the higher ITTC sectioned hull estimate and the lower Hughes sectioned hull estimate. In other words, if the residual resistance has any combination of Reynolds and Froude scaling, the resulting quantity will lie in between the Froude scaled ITTC method and the Reynolds scaled Hughes method.

### 3. Reynolds Scaled Resistances

Figure 4.36 compares the Reynolds scaled portion of the model resistance for each method and also includes the Lockheed skin friction for the model. The Reynolds resistance equaled the frictional resistance for both the ITTC methods. The Reynolds resistance of the Hughes method included both the frictional and form drag components. The Reynolds scaled resistance of the modified Hughes method was comprised of the frictional resistance and the pod portion of the form drag since the strut drag was Froude scaled.

Figure 4.37 shows the result of Reynolds scaling the model resistances of Figure 4.36. The relative order of the ship curves remained the same. In the residual resistance discussion it was shown that Reynolds scaling predicts lower ship quantities when compared to Froude scaling. It will be shown that the methods which Reynolds scaled larger percentages of the model's total resistance predicted lower ship total resistances.

### 4. Froude Scaled Resistances

Figure 4.38 compares the Froude scaled portion of the model resistance for each method. The figure also includes the Lockheed residual which was taken as the Lockheed sum minus the Lockheed skin friction. The Froude resistance equaled the residual resistance for both the ITTC methods. The Froude resistance of the Hughes method was the wave making component only and the Froude scaled resistance of the modified Hughes method included both the wave making and strut portion of the form drag.

Figure 4.39 shows the result of Froude scaling the model resistances of Figure 4.38. The relative order remained the same. It will be shown that assigning larger percentages of the model's total resistance to Froude scaling results in higher ship total resistances since Froude scaling predicts higher ship quantities compared to Reynolds scaling.

The Lockheed residuals were provided in Figures 4.38 and 4.39 for comparative purposes only. It was not within the scope of this thesis to evaluate Lockheed's analysis. It is sufficient to note that the Lockheed evaluation of residual resistance varied from this thesis procedure as evidenced by the difference in model and ship curve shapes for the Lockheed residual resistance.

#### 5. Total Resistance Comparison

All methods started with the same model total resistance. Figure 4.40 compares the predicted ship resistances from each method and Table 1 ranks the ship totals, the frictional and residual divisions of the model and ship. The Lockheed sum, also plotted in Figure 4.40, was less than all analyses covered in the thesis.

The Reynolds and Froude scaled resistance comparison provided the best insight into the analyses of the thesis. Previously, it was stated that Froude scaling a resistance resulted in higher ship values compared to Reynolds scaling. Since the ITTC methods Froude scaled all residual resistances, the ITTC methods predicted the highest ship total resistances. The Hughes method Reynolds scaled all its residual resistance and therefore predicted the lowest total resistance. The modified Hughes method fell between the ITTC and Hughes method because it applied both Reynolds and Froude scaling to portions of its residual resistance. The sectioned hull procedure provided lower ship total resistances compared to the single length procedure. Table 2 summarizes the Reynolds and Froude Number scaling results.

| Rank of Quantities (highest=1, lowest=5) | Model $R_F$ | Model $R_R$ | Ship $R_F$ | Ship $R_R$ | Ship $R_T$ |
|---|---|---|---|---|---|
| ITTC Single Length | 5 | 1 | 5 | 1 | 1 |
| ITTC Sectioned Hull | 2 | 4 | 2 | 2 | 2 |
| Hughes Sectioned Hull | 3 | 2 | 3 | 4 | 4 |
| Modified Hughes | 3 | 2 | 3 | 3 | 3 |
| Lockheed | 1 | 5 | 1 | 5 | 5 |

**Table 1**. Comparison of method derived frictional, residual and total resistances.

| Rank of Quantities (highest=1, lowest=4) | Model $R_{Rn}$ | Model $R_{Fn}$ | Ship $R_{Rn}$ | Ship $R_{Fn}$ | Ship $R_T$ |
|---|---|---|---|---|---|
| ITTC Single Length | 4 | 1 | 4 | 1 | 1 |
| ITTC Sectioned Hull | 3 | 2 | 3 | 2 | 2 |
| Hughes Sectioned Hull | 1 | 4 | 1 | 4 | 4 |
| Modified Hughes | 2 | 3 | 2 | 3 | 3 |

**Table 2**. Comparison of Reynolds and Froude scaled resistance components.

## C. PROPULSION

The ship horsepower or SHP defines whether the ship will meet the desired speed of thirty knots. There are three engines under consideration for the SLICE. The Lycoming TF 40 is the highest rated at 3994 horsepower for continuous operation. With two engines installed and accounting for losses, the delivery of 6850 total installed horsepower is estimated for sustained operation (Lockheed, 1994).

Figure 4.41 shows the predicted SHP versus ship speed and Figure 4.42 shows a close-up of thirty knots. The following observations can be made concerning the desire to cruise at thirty knots. At thirty knots, only the ITTC single length approach estimates a larger horsepower requirement than what the proposed engines can deliver. All other methods suggest that the planned engineering configuration will propel the ship at speeds of greater than thirty knots for sustained operations.

The effective horsepower, EHP, is a means by which a propulsion plant's efficiency can be labeled. It is found by relating the ship total resistance $R_{T_S}$, in pounds force, and the ship velocity $V_S$, in feet per second. The 550 in the denominator converts the value to horsepower.

$$EHP = \frac{R_{T_S} V_S}{550} \tag{128}$$

The SHP is found by dividing the effective horsepower EHP by some propulsive coefficient, PC, here equal to 0.73 (Lockheed, 1994).

$$SHP = \frac{EHP}{PC} \tag{129}$$

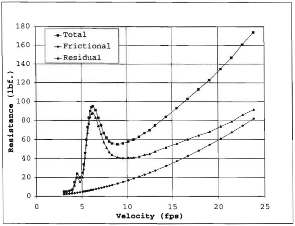


**Figure 4.1.** ITTC model resistances versus model velocity for a single length analysis of the SLICE hull.

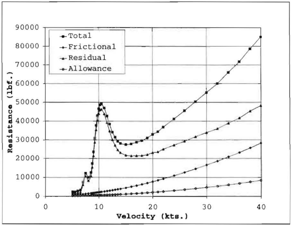


**Figure 4.2.** ITTC ship resistances versus ship velocity for a single length analysis of the SLICE hull.

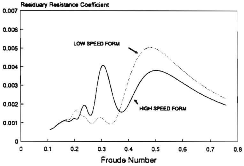


**Figure 4.3.** Residuary resistance coefficients versus Froude Number (Kennell, 1992).

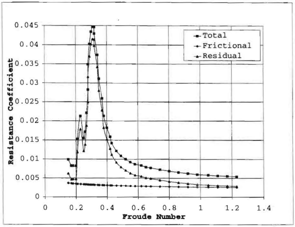


**Figure 4.4.** ITTC model resistance coefficients versus Froude Number for a single length analysis of the SLICE hull.

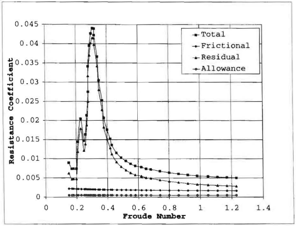


**Figure 4.5.** ITTC ship resistance coefficients versus Froude Number for a single length analysis of the SLICE hull.

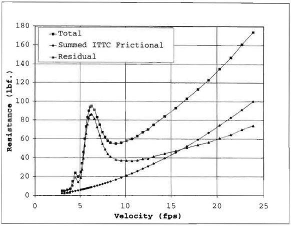


**Figure 4.6.** ITTC model resistances versus model velocity for the sectionalized SLICE hull.

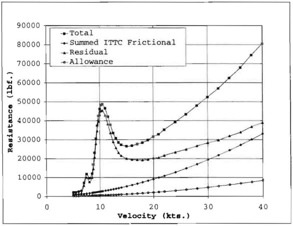


**Figure 4.7.** ITTC ship resistances versus ship velocity for the sectionalized SLICE hull.

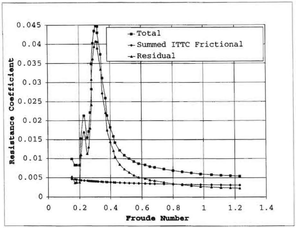


**Figure 4.8.** ITTC model resistance coefficients versus Froude Number for the sectionalized SLICE hull.

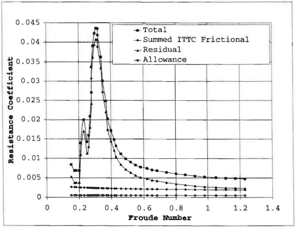


**Figure 4.9.** ITTC ship resistance coefficients versus Froude Number for the sectionalized SLICE hull.

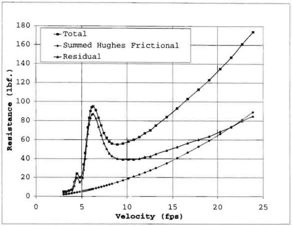


**Figure 4.10.** Hughes model resistances versus model velocity for the sectionalized SLICE hull.

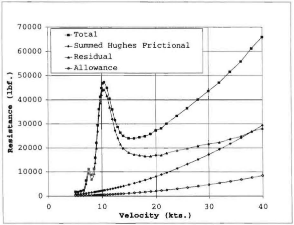


**Figure 4.11.** Hughes ship resistances versus ship velocity for the sectionalized SLICE hull.

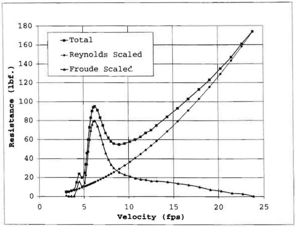


**Figure 4.12**. Hughes model resistances as functions of Reynolds and Froude Numbers versus model velocity for a sectionalized SLICE hull.

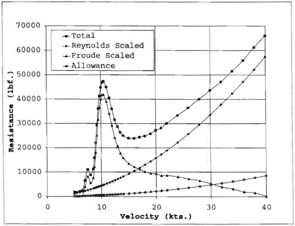


**Figure 4.13**. Hughes ship resistances as functions of Reynolds and Froude Numbers versus ship velocity for the sectionalized SLICE hull.

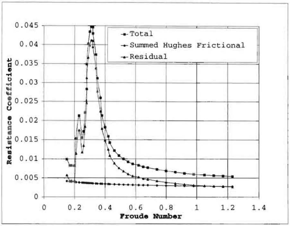


**Figure 4.14.** Hughes model resistance coefficients versus Froude Number for the sectionalized SLICE hull.

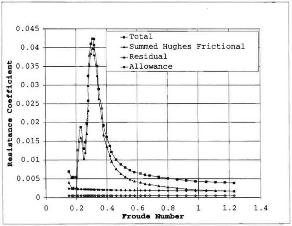


**Figure 4.15.** Hughes ship resistance coefficients versus Froude Number for the sectionalized SLICE hull.

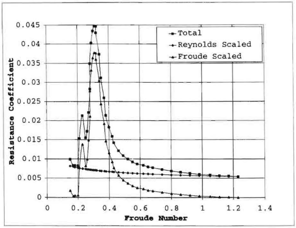


**Figure 4.16.** Hughes model resistance coefficients as functions of Reynolds and Froude Numbers versus Froude Number for the sectionalized SLICE hull.

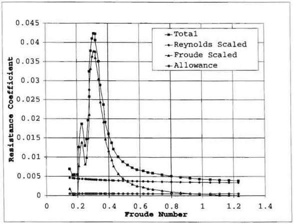


**Figure 4.17.** Hughes ship resistance coefficients as functions of Reynolds and Froude Numbers versus Froude Number for the sectionalized SLICE hull.

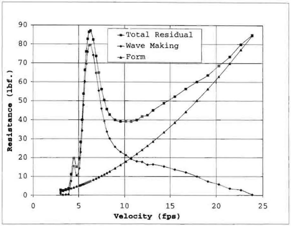


**Figure 4.18**. Hughes model residual resistances versus model velocity for the sectionalized SLICE hull.

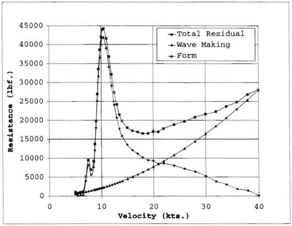


**Figure 4.19**. Hughes ship residual resistances versus ship velocity for the sectionalized SLICE hull.

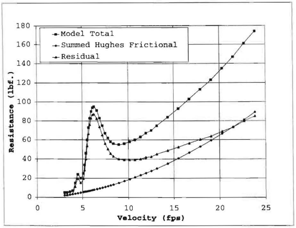


**Figure 4.20**. Modified Hughes model resistances versus model velocity for the sectionalized SLICE hull.

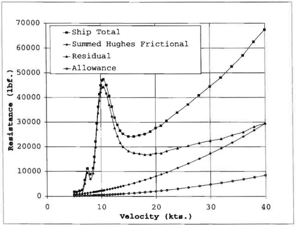


**Figure 4.21**. Modified Hughes ship resistances versus ship velocity for the sectionalized SLICE hull.

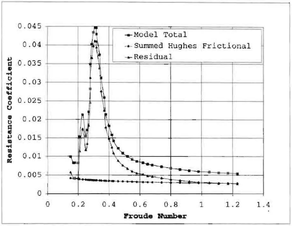


**Figure 4.22**. Modified Hughes model resistance coefficients versus Froude Number for the sectionalized SLICE hull.

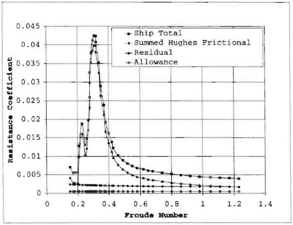


**Figure 4.23**. Modified Hughes ship resistance coefficients versus Froude Number for the sectionalized SLICE hull.

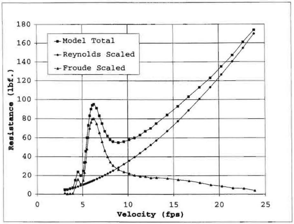


**Figure 4.24.** Modified Hughes model resistances as functions of Reynolds and Froude Numbers versus model velocity for the sectionalized SLICE hull.

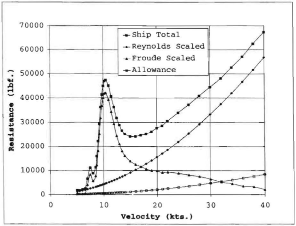


**Figure 4.25.** Modified Hughes ship resistances as functions of Reynolds and Froude Numbers versus ship velocity for the sectionalized SLICE hull.

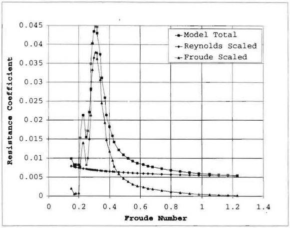


**Figure 4.26.** Modified Hughes model resistance coefficients as functions of Reynolds and Froude Numbers versus Froude Number for the sectionalized SLICE hull.

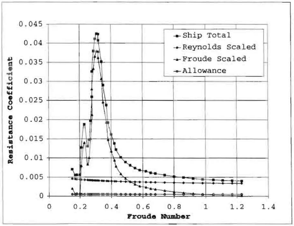


**Figure 4.27.** Modified Hughes ship resistance coefficients as functions of Reynolds and Froude Numbers versus Froude Number for the sectionalized SLICE hull.

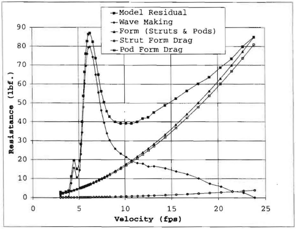


**Figure 4.28**. Modified Hughes model residual resistances versus model velocity for the sectionalized SLICE hull.

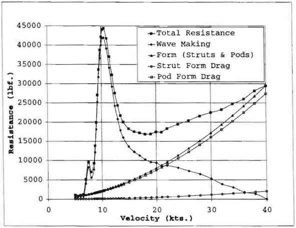


**Figure 4.29**. Modified Hughes ship residual resistances versus ship velocity for the sectionalized SLICE hull.

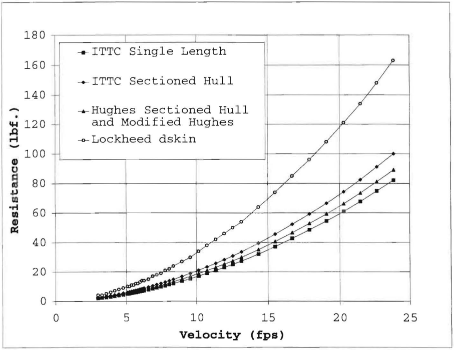


**Figure 4.30.** Comparison of model frictional resistances.

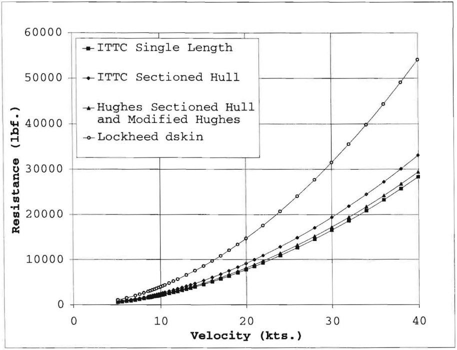


**Figure 4.31.** Comparison of ship frictional resistances.

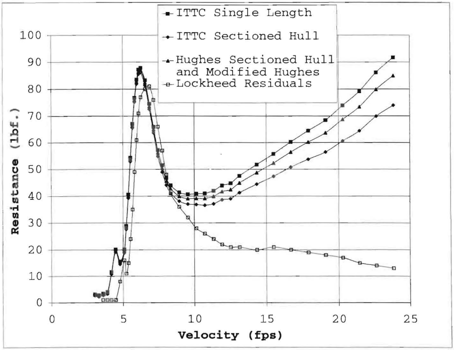


**Figure 4.32.** Comparison of model residual resistances.

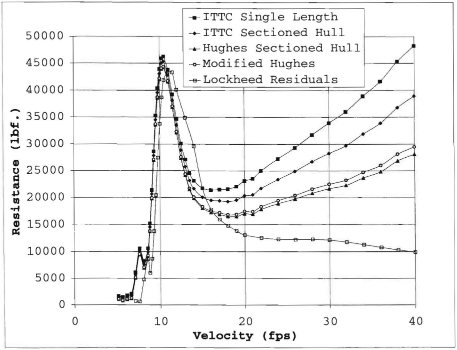


**Figure 4.33.** Comparison of ship residual resistances.

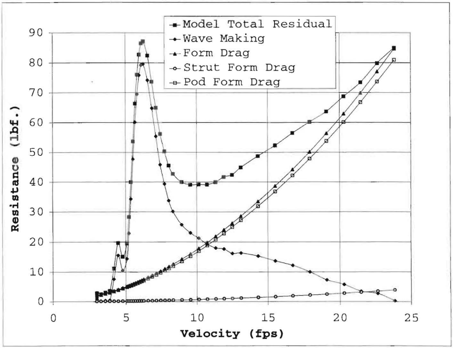


**Figure 4.34.** Comparison of the model residual resistance division for the Hughes and modified Hughes methods.

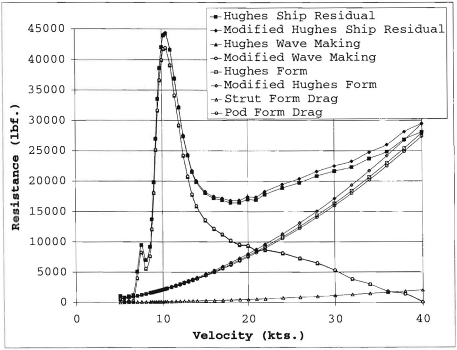


**Figure 4.35.** Comparison of ship residual resistance division for the Hughes and modified Hughes methods.

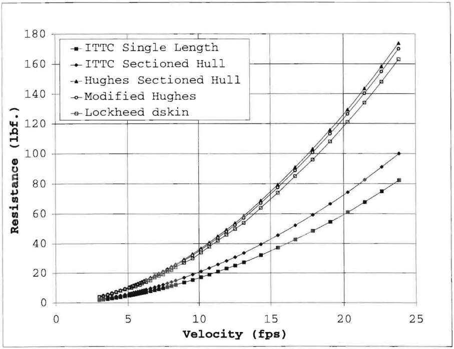


**Figure 4.36.** Comparison of the Reynolds scaled portion of the model resistance.

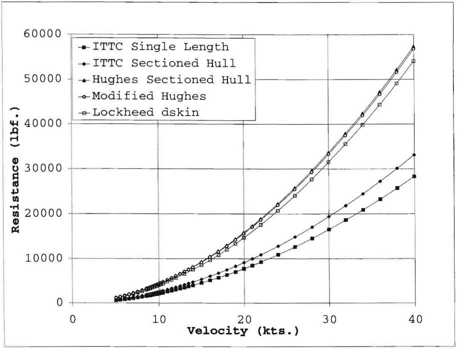


**Figure 4.37.** Comparison of the ship Reynolds scaled resistances.

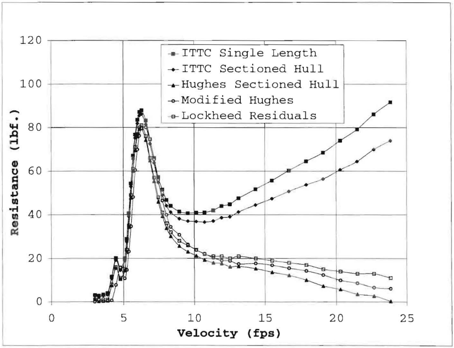


**Figure 4.38.** Comparison of the Froude scaled portion of the model resistance.

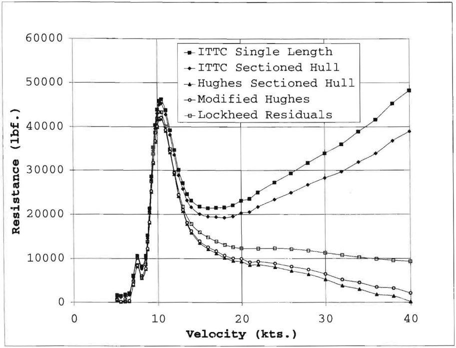


**Figure 4.39**. Comparison of the ship Froude scaled resistances.

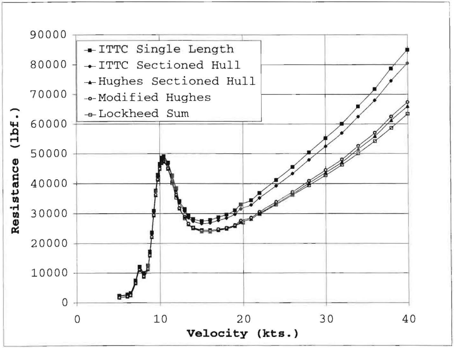


**Figure 4.40**. Comparison of the ship total resistances.

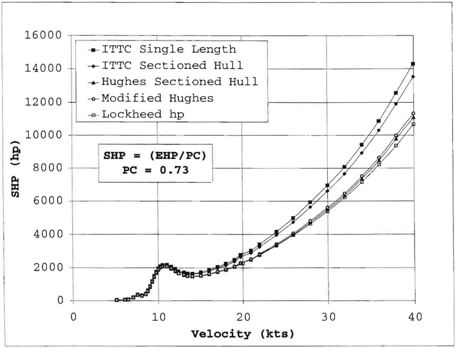


**Figure 4.41.** Comparison of calculated SHP versus ship velocity.

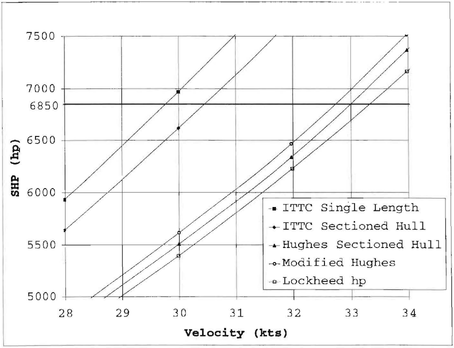


**Figure 4.42.** Close-up of the SHP curves near 30 knots.

## V. CONCLUSIONS AND RECOMMENDATIONS

### A. CONCLUSION

The wetted surface area of the SLICE hull form is radically different from a full displacement monohull and also varies significantly from the SWATH hull. Because of this, standard procedures for predicting ship resistances from model test tank data cannot be used.

The thesis decomposed the total resistance into pod and strut components and further divided these into frictional, form and wave making components. Additionally, the resistances were categorized as functions of the Reynolds and Froude Numbers. The Hughes method provided the means by which the residual resistance was divided into form and wave making components. Ship scaling processes do not usually decompose the form drag, but in the case of the SLICE, two factors lead to a further investigation of the form drag. First, the model had a large form factor which meant that the form drag was almost equal to the frictional resistance. Second, the geometry of the wetted surface area provided a natural separation of the hull for unattached strut and pod analysis.

A large difference between the ITTC and Hughes predictions existed so a modified Hughes method was developed which combined ideas from both processes. In particular, the pod form drag was Reynolds scaled according to the Hughes and the strut form drag was Froude scaled as in the ITTC method. The hybrid procedure examination results fell in between the ITTC and Hughes estimates.

Concerning the design criterion that the ship go at least thirty knots, only the classical ITTC single length determined that the ship required more power. But, as previously stated, the ITTC single length resistance was concluded to be an overestimate. Assuming the propulsive coefficient does not vary much from the designer's value of 0.73, the Hughes and the modified Hughes method predict that thirty knots is achievable.

### B. RECOMMENDATIONS FOR FURTHER RESEARCH

Follow-on research should include further investigation of the breakup of the form drag. In particular, a computational fluid dynamic study of the struts and pods as separate entities could be done to validate the modified Hughes method. This analysis might lead to a different division of Reynolds and Froude scaled quantities.

It would be beneficial to include the stabilizers and canards in resistance calculations. This was not done here because the dimensions of these were not known since they were not on the ship drawings. These components would most likely be Reynolds scaled since they are similar to flat plates. Additionally, the effect of varying the angles of the stabilizers and canards could be studied via computational fluid dynamics.

## APPENDIX A. WETTED SURFACE AREA CALCULATION

The wetted surface area of the SLICE hull was calculated from the ship drawings (Lockheed, 1994). The waterline was 14 feet. Tables 3 through 10 show the calculations used to determine the surfaces of the submerged hull shown in Figures 3.1 through 3.4. Where separate calculated surface areas overlapped, appropriate area values were subtracted form the total.

| Ship Station (ft.) | Drawings Vertical Height (1/32 ") | Ship Vertical Height (ft.) | Horizontal Distance From Strut CL (ft.) | Ship Surface Chord (ft.) | Simpson Rule Multiplier | Simpson Weighted Chord (ft.) | Simpson Rule Sums | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|---|---|
| -7.45 | 0 | 0 | 0.00 | 0.00 | | | | | |
| -7.00 | 2 | 0.25 | 0.06 | 0.26 | 1 | 0.26 | | 0.06 | 0.06 |
| -6.00 | 6 | 0.75 | 0.21 | 0.78 | 4 | 3.11 | | | 0.52 |
| -5.00 | 10 | 1.25 | 0.35 | 1.30 | 2 | 2.60 | | | 1.04 |
| -4.00 | 15 | 1.875 | 0.49 | 1.94 | 4 | 7.75 | Simpson | | 1.62 |
| -3.00 | 20 | 2.5 | 0.63 | 2.58 | 2 | 5.16 | 1/3 rd. | | 2.26 |
| -2.00 | 24 | 3 | 0.78 | 3.10 | 4 | 12.39 | sum | | 2.84 |
| -1.00 | 28 | 3.5 | 0.92 | 3.62 | 1 | 3.62 | 34.89 | 11.63 | 3.36 |
| 0.00 | 32 | 4 | 1.06 | 4.14 | 1 | 4.14 | | 3.88 | 3.88 |
| 0.50 | 14 | 1.75 | 0.07 | 1.75 | 4 | 7.01 | | | 1.47 |
| 1.00 | 8 | 1 | 0.07 | 1.00 | 2 | 2.01 | | | 0.69 |
| 1.50 | 4 | 0.5 | 0.07 | 0.51 | 4 | 2.02 | Simpson | | 0.38 |
| 2.00 | 3 | 0.375 | 0.07 | 0.38 | 2 | 0.76 | 1/3 rd. | | 0.22 |
| 2.50 | 1.5 | 0.1875 | 0.07 | 0.20 | 4 | 0.80 | sum | | 0.15 |
| 3.00 | 0 | 0 | 0.00 | 0.00 | 1 | 0.00 | 16.73 | 2.79 | 0.05 |
| | | | | Total Area of AREA 1 (One Side) = | | | | 18.36 | |
| | | | | Trapezoidal Strip Area Comparison ------------ | | | | | 18.52 |

**Table 3**. Calculation of Wetted Surface Area One.

| Ship Station (ft.) | Drawings Vertical Height (1/32 ") | Ship Vertical Height (ft.) | Horizontal Distance From Strut CL (ft.) | Ship Surface Chord (ft.^2) | Simpson Rule Multiplier | Simpson Weighted Chord (ft.) | Simpson Rule Sums | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|---|---|
| 50.00 | 0 | 0 | 0.00 | 0.00 | | | | | |
| 57.80 | 32 | 4 | 1.11 | 4.15 | | | | 16.19 | 16.19 |
| 58.00 | 16 | 2 | 1.14 | 2.30 | 1 | 2.30 | | 0.65 | 0.65 |
| 58.50 | 9 | 1.125 | 1.21 | 1.65 | 4 | 6.61 | Simpson | | 0.99 |
| 59.00 | 5 | 0.625 | 1.28 | 1.43 | 2 | 2.85 | 1/3 rd. | | 0.77 |
| 59.50 | 3 | 0.375 | 1.35 | 1.40 | 4 | 5.61 | sum | | 0.71 |
| 60.00 | 2 | 0.25 | 1.42 | 1.45 | 1 | 1.45 | 18.82 | 3.14 | 0.71 |
| 60.67 | 0 | 0 | 0.00 | 0.00 | | | | 0.48 | 0.48 |
| | | | | Total Area of AREA 2 (One Side) = | | | | 19.97 | |
| | | | | Trapezoidal Strip Area Check ------------------ | | | | | 20.49 |

**Table 4**. Calculation of Wetted Surface Area Two.

| Ship Station (ft.) | Drawings Depth (1/4" = 1') (1/32 ") | Ship Vertical Depth (ft.) | Simpson Rule Multiplier | Simpson Weight Chord (ft.) | Simpson Rule Sums (ft.) | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|
| 0.00 | 48 | 6.00 | 1 | 6.00 | | | |
| 0.50 | 50 | 6.25 | 4 | 25.00 | | | 3.06 |
| 1.00 | 50 | 6.25 | 2 | 12.50 | | | 3.13 |
| 1.50 | 51 | 6.38 | 4 | 25.50 | Simpson | | 3.16 |
| 2.00 | 49 | 6.13 | 2 | 12.25 | 1/3 rd. | | 3.13 |
| 2.50 | 47 | 5.88 | 4 | 23.50 | sum | | 3.00 |
| 3.00 | 47 | 5.88 | 1 | 5.88 | 110.63 | 18.44 | 2.94 |
| 4.00 | 43 | 5.38 | 4 | 21.50 | Simpson | | 5.63 |
| 5.00 | 41 | 5.13 | 2 | 10.25 | 1/3 rd. | | 5.25 |
| 6.00 | 39 | 4.88 | 4 | 19.50 | sum | | 5.00 |
| 7.00 | 38 | 4.75 | 1 | 4.75 | 61.88 | 20.63 | 4.81 |
| 17.00 | 38 | 4.75 | | | | 47.50 | 47.50 |
| 24.00 | 57 | 7.13 | | | | 41.56 | 41.56 |
| | | Total Area of AREA 3 (One Side)= | | | | 128.13 | |
| | | Trapezoidal Strip Area check ------------------ | | | | | 128.16 |

**Table 5**. Calculation of Wetted Surface Area Three.

| Ship Station (ft.) | Drawings Vertical (1/4 " = 1') (1/32 ") | Ship Vertical Depth (ft.) | Simpson Rule Multiplier | Simpson Weight Chord (ft.) | Simpson Chord Sums (ft.) | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|
| 57.67 | 16 | 2.00 | | | | | |
| 58.00 | 31 | 3.88 | 1 | 3.88 | | 0.98 | 0.98 |
| 58.50 | 36 | 4.50 | 4 | 18.00 | Simpson | | 2.09 |
| 59.00 | 40 | 5.00 | 2 | 10.00 | 1/3 rd. | | 2.38 |
| 59.50 | 38 | 4.75 | 4 | 19.00 | sum | | 2.44 |
| 60.00 | 41 | 5.13 | 1 | 5.13 | 56.00 | 9.33 | 2.47 |
| 60.67 | 40 | 5.00 | | | | 3.38 | 3.38 |
| 61.00 | 38 | 4.75 | 1 | 4.75 | | 1.62 | 1.62 |
| 62.00 | 38 | 4.75 | 4 | 19.00 | | | 4.75 |
| 63.00 | 38 | 4.75 | 2 | 9.50 | | | 4.75 |
| 64.00 | 38 | 4.75 | 4 | 19.00 | | | 4.75 |
| 65.00 | 38 | 4.75 | 2 | 9.50 | | | 4.75 |
| 66.00 | 38 | 4.75 | 4 | 19.00 | | | 4.75 |
| 67.00 | 40 | 5.00 | 2 | 10.00 | | | 4.88 |
| 68.00 | 42 | 5.25 | 4 | 21.00 | | | 5.13 |
| 69.00 | 45 | 5.63 | 2 | 11.25 | | | 5.44 |
| 70.00 | 48 | 6.00 | 4 | 24.00 | | | 5.81 |
| 71.00 | 51 | 6.38 | 2 | 12.75 | | | 6.19 |
| 72.00 | 53 | 6.63 | 4 | 26.50 | | | 6.50 |
| 73.00 | 55 | 6.88 | 2 | 13.75 | | | 6.75 |
| 74.00 | 57 | 7.13 | 4 | 28.50 | | | 7.00 |
| 75.00 | 59 | 7.38 | 2 | 14.75 | | | 7.25 |
| 76.00 | 61 | 7.63 | 4 | 30.50 | | | 7.50 |
| 77.00 | 62 | 7.75 | 2 | 15.50 | | | 7.69 |
| 78.00 | 63 | 7.88 | 4 | 31.50 | Simpson | | 7.81 |
| 79.00 | 65 | 8.13 | 2 | 16.25 | 1/3 rd. | | 8.00 |
| 80.00 | 67 | 8.38 | 4 | 33.50 | sum | | 8.25 |
| 81.00 | 69 | 8.63 | 1 | 8.63 | 379.13 | 126.38 | 8.50 |
| 81.67 | 71 | 8.88 | | | | 5.83 | 5.83 |
| | | | | | | | |
| | | Total Area of AREA 4 (One Side) = | | | | 147.52 | |
| | | Trapezoidal Strip Area check ------------------ | | | | | 147.63 |

**Table 6**. Calculation of Wetted Surface Area Four.

| Ship Station (ft.) | Point "A" coords X (inch) | Point "A" coords Y (inch) | Point "B" coords X (inch) | Point "B" coords Y (inch) | Ship Chord AB (ft.) | Simpson Rule Multiplier | Simpson Weight Chord (ft.) | Simpson Rule Sums (ft.) | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | |
| 0.13 | 8.76 | 5.06 | 5.18 | 11.26 | 0.60 | | | | 0.04 | 0.04 |
| 0.25 | 12.25 | 7.07 | 6.10 | 17.74 | 1.03 | | | | 0.10 | 0.10 |
| 0.50 | 16.94 | 9.78 | 8.12 | 25.05 | 1.47 | 1 | 1.47 | | 0.31 | 0.31 |
| 1.00 | 22.50 | 12.99 | 11.36 | 32.29 | 1.86 | 4 | 7.43 | | | 0.83 |
| 1.50 | 27.36 | 15.80 | 13.66 | 39.54 | 2.28 | 2 | 4.57 | | | 1.04 |
| 2.00 | 30.23 | 17.45 | 15.68 | 42.65 | 2.42 | 4 | 9.70 | | | 1.18 |
| 2.50 | 33.09 | 19.10 | 16.95 | 47.06 | 2.69 | 2 | 5.38 | | | 1.28 |
| 3.00 | 35.08 | 20.25 | 17.84 | 50.11 | 2.87 | 4 | 11.49 | | | 1.39 |
| 3.50 | 36.75 | 21.22 | 18.42 | 52.97 | 3.06 | 2 | 6.11 | | | 1.48 |
| 4.00 | 38.35 | 22.14 | 18.95 | 55.74 | 3.23 | 4 | 12.93 | Simpson | | 1.57 |
| 4.50 | 39.19 | 22.63 | 19.22 | 57.21 | 3.33 | 2 | 6.66 | 1/3 rd. | | 1.64 |
| 5.00 | 40.03 | 23.11 | 19.50 | 58.67 | 3.42 | 4 | 13.69 | sum | | 1.69 |
| 5.50 | 40.81 | 23.56 | 19.50 | 60.48 | 3.55 | 1 | 3.55 | 82.98 | 13.83 | 1.74 |
| 6.00 | 41.14 | 23.75 | 19.50 | 61.24 | 3.61 | | | | 1.79 | 1.79 |
| 6.65 | 41.57 | 24.00 | 19.50 | 62.23 | 3.68 | | | | 2.37 | 2.37 |
| 7.75 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | | | | 3.90 | 3.90 |
| 8.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3 41 | 1 | 3.41 | | 0.85 | 0.85 |
| 8.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | | | 1.71 |
| 9.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 2 | 6.82 | | | 1.71 |
| 9.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | | | 1.71 |
| 10.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 2 | 6.82 | | | 1.71 |
| 10.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | | | 1.71 |
| 11.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 2 | 6.82 | | | 1.71 |
| 11.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | | | 1.71 |
| 12.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 2 | 6.82 | | | 1.71 |
| 12.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | Simpson | | 1.71 |
| 13.00 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 2 | 6.82 | 1/3 rd. | | 1.71 |
| 13.50 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | 4 | 13.64 | sum | | 1.71 |
| 14.00 | 38.68 | 28.43 | 20.77 | 59.44 | 2.98 | 1 | 2.98 | 122.34 | 20.39 | 1.60 |
| 15.00 | 35.04 | 32.80 | 19.67 | 59.44 | 2.56 | | | | 2.77 | 2.77 |
| 16.00 | 32.46 | 35.36 | 18.56 | 59.44 | 2.32 | | | | 2.44 | 2.44 |
| 16.37 | 31.19 | 36.49 | 17.94 | 59.44 | 2.21 | | | | 0.84 | 0.84 |
| 17.00 | 29.96 | 36.91 | 15.35 | 62.23 | 2.44 | | | | 1.46 | 1.46 |
| 18.00 | 25.08 | 39.50 | 13.57 | 59.43 | 1.92 | 1 | 1.92 | | 2.18 | 2.18 |
| 19.00 | 19.12 | 41.83 | 11.55 | 54.94 | 1.26 | 4 | 5.05 | | | 1.59 |
| 20.00 | 14.56 | 41.59 | 9.33 | 50.67 | 0.87 | 2 | 1.75 | | | 1.07 |
| 21.00 | 10.03 | 41.36 | 7.01 | 46.59 | 0.50 | 4 | 2.01 | Simpson | | 0.69 |
| 22.00 | 6.53 | 39.36 | 4.65 | 42.62 | 0.31 | 2 | 0.63 | 1/3 rd. | | 0.41 |
| 23.00 | 3.18 | 37.10 | 2.29 | 38.64 | 0.15 | 4 | 0.59 | sum | | 0.23 |
| 24.00 | 0.00 | 34.54 | 0.00 | 34.54 | 0.00 | 1 | 0.00 | 11.94 | 3.98 | 0.07 |
| | | | | Total Surface Area of AREA 5 (One Side) = | | | | | 57.25 | |
| | | | | Trapezoidal Strip Area Check ----------------------- | | | | | | 57.30 |

**Table 7**. Calculation of Wetted Surface Area Five.

| Ship | Point "A" coord. | | Point "B" coord. | | Ship | Simpson | Simpson | Simpson | Ship | Trapezoid |
|---|---|---|---|---|---|---|---|---|---|---|
| Station | X | Y | X | Y | Chord | Rule | Weight | sums | Surface | Strip |
| | | | | | \|AB\| | Multiplier | Chord | | Area | Area |
| (ft.) | (inch) | (inch) | (inch) | (inch) | (ft.) | | (ft.) | (ft.) | (ft.^2) | (ft.^2) |
| 57.67 | 0.00 | 48.00 | 0.00 | 48.00 | 0.00 | | | | | |
| 58.00 | 7.81 | 47.36 | 6.83 | 49.05 | 0.16 | 1 | 0.16 | | 0.03 | 0.03 |
| 59.00 | 17.65 | 44.64 | 13.04 | 52.62 | 0.77 | 4 | 3.07 | Simpson | | 0.47 |
| 60.00 | 25.95 | 40.38 | 16.60 | 56.58 | 1.56 | 2 | 3.12 | 1/3 rd. | | 1.16 |
| 61.00 | 32.90 | 34.95 | 18.30 | 60.24 | 2.43 | 4 | 9.73 | sum | | 2.00 |
| 62.00 | 38.56 | 28.58 | 19.19 | 62.13 | 3.23 | 1 | 3.23 | 19.31 | 6.44 | 2.83 |
| 62.65 | 41.57 | 24.00 | 19.50 | 62.23 | 3.68 | | | | 2.24 | 2.24 |
| 62.75 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | | | | 0.35 | 0.35 |
| 65.78 | 41.57 | 24.00 | 21.11 | 59.44 | 3.41 | | | | 10.33 | 10.33 |
| 67.00 | 36.83 | 30.04 | 19.50 | 60.06 | 2.89 | 1 | 2.89 | | 3.84 | 3.84 |
| 68.00 | 32.84 | 33.31 | 19.50 | 56.40 | 2.22 | 4 | 8.89 | | | 2.56 |
| 69.00 | 29.35 | 35.44 | 19.50 | 52.50 | 1.64 | 2 | 3.28 | | | 1.93 |
| 70.00 | 27.55 | 34.38 | 19.50 | 48.33 | 1.34 | 4 | 5.37 | | | 1.49 |
| 71.00 | 25.47 | 33.58 | 19.50 | 43.86 | 0.99 | 2 | 1.98 | | | 1.17 |
| 72.00 | 23.56 | 32.20 | 18.81 | 40.43 | 0.79 | 4 | 3.17 | | | 0.89 |
| 73.00 | 21.92 | 30.11 | 17.70 | 37.42 | 0.70 | 2 | 1.41 | | | 0.75 |
| 74.00 | 20.02 | 28.19 | 16.55 | 34.21 | 0.58 | 4 | 2.32 | | | 0.64 |
| 75.00 | 17.89 | 36.44 | 14.77 | 31.83 | 0.46 | 2 | 0.93 | | | 0.52 |
| 76.00 | 15.53 | 24.80 | 12.90 | 29.35 | 0.44 | 4 | 1.75 | | | 0.45 |
| 77.00 | 12.98 | 23.22 | 10.83 | 26.94 | 0.36 | 2 | 0.72 | | | 0.40 |
| 78.00 | 10.30 | 21.61 | 8.60 | 24.55 | 0.28 | 4 | 1.13 | Simpson | | 0.32 |
| 79.00 | 7.51 | 19.91 | 6.24 | 22.12 | 0.21 | 2 | 0.42 | 1/3 rd. | | 0.25 |
| 80.00 | 4.67 | 18.03 | 3.88 | 19.40 | 0.13 | 4 | 0.53 | sum | | 0.17 |
| 81.00 | 1.84 | 15.86 | 1.52 | 16.41 | 0.05 | 1 | 0.05 | 34.83 | 11.61 | 0.09 |
| 81.67 | 0.00 | 14.20 | 0.00 | 14.20 | 0.00 | | | | 0.02 | 0.02 |
| | | | | | | | | | | |
| | | | | Total Surface Area of AREA 6 (One Side) = | | | | | 34.87 | |
| | | | | Trapezoidal Rule Strip Area Check ------------------ | | | | | | 34.90 |
| | | | | | | | | | | |

**Table 8**. Calculation of Wetted Surface Area Six.

| Ship Station | Point "A" coord. X | Y | Ship FWD Pod Diameter | Ship FWD Pod Circumf. | Simpson Multiplier | Simpson Weight Chord | Simpson sums | Ship Surface Area | Trapezoid Strip Area |
|---|---|---|---|---|---|---|---|---|---|
| (ft.) | (inch) | (inch) | (ft.) | (ft.) | | (ft.) | (ft.) | (ft.^2) | (ft.^2) |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | |
| 0.13 | 8.76 | 5.06 | 1.69 | 3.53 | | | | 0.23 | 0.23 |
| 0.25 | 12.25 | 7.07 | 2.36 | 4.94 | | | | 0.51 | 0.51 |
| 0.50 | 16.94 | 9.78 | 3.26 | 6.83 | 1 | 6.83 | | 1.47 | 1.47 |
| 1.00 | 22.50 | 12.99 | 4.33 | 9.07 | 4 | 36.28 | | | 3.97 |
| 1.50 | 27.36 | 15.80 | 5.27 | 11.03 | 2 | 22.06 | | | 5.02 |
| 2.00 | 30.23 | 17.45 | 5.82 | 12.18 | 4 | 48.73 | | | 5.80 |
| 2.50 | 33.09 | 19.10 | 6.37 | 13.34 | 2 | 26.67 | | | 6.38 |
| 3.00 | 35.08 | 20.25 | 6.75 | 14.14 | 4 | 56.55 | | | 6.87 |
| 3.50 | 36.75 | 21.22 | 7.07 | 14.81 | 2 | 29.63 | | | 7.24 |
| 4.00 | 38.35 | 22.14 | 7.38 | 15.46 | 4 | 61.83 | Simpson | | 7.57 |
| 4.50 | 39.19 | 22.63 | 7.54 | 15.80 | 2 | 31.59 | 1/3 rd. | | 7.81 |
| 5.00 | 40.03 | 23.11 | 7.70 | 16.13 | 4 | 64.54 | sum | | 7.98 |
| 5.50 | 40.81 | 23.56 | 7.85 | 16.45 | 1 | 16.45 | 401.16 | 66.86 | 8.15 |
| 6.00 | 41.14 | 23.75 | 7.92 | 16.58 | | | | 8.26 | 8.26 |
| 6.65 | 41.57 | 24.00 | 8.00 | 16.76 | | | | 10.83 | 10.83 |
| 7.75 | 41.57 | 24.00 | 8.00 | 16.76 | | | | 18.43 | 18.43 |
| 8.00 | 41.57 | 24.00 | 8.00 | 16.76 | 1 | 16.76 | | 4.19 | 4.19 |
| 8.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | | | 8.38 |
| 9.00 | 41.57 | 24.00 | 8.00 | 16.76 | 2 | 33.51 | | | 8.38 |
| 9.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | | | 8.38 |
| 10.00 | 41.57 | 24.00 | 8.00 | 16.76 | 2 | 33.51 | | | 8.38 |
| 10.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | | | 8.38 |
| 11.00 | 41.57 | 24.00 | 8.00 | 16.76 | 2 | 33.51 | | | 8.38 |
| 11.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | | | 8.38 |
| 12.00 | 41.57 | 24.00 | 8.00 | 16.76 | 2 | 33.51 | | | 8.38 |
| 12.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | Simpson | | 8.38 |
| 13.00 | 41.57 | 24.00 | 8.00 | 16.76 | 2 | 33.51 | 1/3 rd. | | 8.38 |
| 13.50 | 41.57 | 24.00 | 8.00 | 16.76 | 4 | 67.02 | sum | | 8.38 |
| 14.00 | 38.68 | 28.43 | 8.00 | 17.64 | 1 | 17.64 | 604.08 | 100.68 | 8.60 |
| 15.00 | 35.04 | 32.80 | 8.00 | 18.58 | | | | 18.11 | 18.11 |
| 16.00 | 32.46 | 35.36 | 8.00 | 19.19 | | | | 18.89 | 18.89 |
| 16.37 | 31.19 | 36.49 | 8.00 | 19.48 | | | | 7.15 | 7.15 |
| 17.00 | 29.96 | 36.91 | 7.92 | 19.49 | | | | 12.27 | 12.27 |
| 18.00 | 25.08 | 39.50 | 7.80 | 20.09 | 1 | 20.09 | | 19.79 | 19.79 |
| 19.00 | 19.12 | 41.83 | 7.67 | 20.80 | 4 | 83.18 | | | 20.44 |
| 20.00 | 14.56 | 41.59 | 7.34 | 20.60 | 2 | 41.20 | | | 20.70 |
| 21.00 | 10.03 | 41.36 | 7.09 | 20.60 | 4 | 82.38 | Simpson | | 20.60 |
| 22.00 | 6.53 | 39.36 | 6.65 | 19.80 | 2 | 39.59 | 1/3 rd. | | 20.20 |
| 23.00 | 3.18 | 37.10 | 6.21 | 18.97 | 4 | 75.86 | sum | | 19.38 |
| 24.00 | 0.00 | 34.54 | 5.76 | 18.09 | 1 | 18.09 | 360.40 | 120.13 | 18.53 |
| 33.75 | 0.00 | 8.25 | 1.38 | 4.32 | | | | 109.22 | 109.22 |
| | | | | | | | | | |
| | | | | Total Surface Area of AREA 7 = | | | | 517.03 | |
| | | | | Trapezoidal Strip Area Check ----------------- | | | | | 516.75 |

**Table 9**. Calculation of Wetted Surface Area Seven.

| Ship Station (ft.) | Point "A" coord. X (inch) | Point "A" coord. Y (inch) | Ship AFT Pod Diameter (ft.) | Ship AFT Pod Circumf. (ft.) | Simpson Multiplier | Simpson Weight Chord (ft.) | Simpson Rule Sums (ft.) | Ship Surface Area (ft.^2) | Trapezoid Strip Area (ft.^2) |
|---|---|---|---|---|---|---|---|---|---|
| 51.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1 | 0.00 | | | |
| 52.00 | 0.00 | 26.25 | 4.38 | 13.74 | 4 | 54.98 | | | 6.87 |
| 53.00 | 0.00 | 34.50 | 5.75 | 18.06 | 2 | 36.13 | | | 15.90 |
| 54.00 | 0.00 | 40.50 | 6.75 | 21.21 | 4 | 84.82 | Simpson | | 19.63 |
| 55.00 | 0.00 | 44.25 | 7.38 | 23.17 | 2 | 46.34 | 1/3 rd. | | 22.19 |
| 56.00 | 0.00 | 46.50 | 7.75 | 24.35 | 4 | 97.39 | sum | | 23.76 |
| 57.00 | 0.00 | 47.25 | 7.88 | 24.74 | 1 | 24.74 | 344.40 | 114.80 | 24.54 |
| 57.67 | 0.00 | 48.00 | 8.00 | 25.13 | | | | 16.62 | 16.62 |
| 58.00 | 7.81 | 47.36 | 8.00 | 25.13 | 1 | 25.13 | | 8.38 | 8.38 |
| 59.00 | 17.65 | 44.64 | 8.00 | 22.12 | 4 | 88.49 | Simpson | | 23.63 |
| 60.00 | 25.95 | 40.38 | 8.00 | 20.56 | 2 | 41.13 | 1/3 rd. | | 21.34 |
| 61.00 | 32.90 | 34.95 | 8.00 | 19.09 | 4 | 76.36 | sum | | 19.83 |
| 62.00 | 38.56 | 28.58 | 8.00 | 17.67 | 1 | 17.67 | 248.78 | 82.93 | 18.38 |
| 62.65 | 41.57 | 24.00 | 8.00 | 16.76 | | | | 11.19 | 11.19 |
| 62.75 | 41.57 | 24.00 | 8.00 | 16.76 | | | | 1.68 | 1.68 |
| 65.78 | 41.57 | 24.00 | 8.00 | 16.76 | | | | 50.77 | 50.77 |
| 67.00 | 36.83 | 30.04 | 7.92 | 17.86 | 1 | 17.86 | | 21.12 | 21.12 |
| 68.00 | 32.84 | 33.31 | 7.80 | 18.42 | 4 | 73.70 | | | 18.14 |
| 69.00 | 29.35 | 35.44 | 7.67 | 18.79 | 2 | 37.58 | | | 18.61 |
| 70.00 | 27.55 | 34.38 | 7.34 | 18.11 | 4 | 72.43 | | | 18.45 |
| 71.00 | 25.47 | 33.58 | 7.02 | 17.51 | 2 | 35.02 | | | 17.81 |
| 72.00 | 23.56 | 32.20 | 6.65 | 16.69 | 4 | 66.76 | | | 17.10 |
| 73.00 | 21.92 | 30.11 | 6.21 | 15.59 | 2 | 31.19 | | | 16.14 |
| 74.00 | 20.02 | 28.19 | 5.76 | 14.55 | 4 | 58.18 | | | 15.07 |
| 75.00 | 17.89 | 36.44 | 6.77 | 18.17 | 2 | 36.34 | | | 16.36 |
| 76.00 | 15.53 | 24.80 | 4.88 | 12.59 | 4 | 50.37 | | | 15.38 |
| 77.00 | 12.98 | 23.22 | 4.43 | 11.67 | 2 | 23.34 | | | 12.13 |
| 78.00 | 10.30 | 21.61 | 3.99 | 10.76 | 4 | 43.04 | Simpson | | 11.21 |
| 79.00 | 7.51 | 19.91 | 3.55 | 9.86 | 2 | 19.73 | 1/3 rd. | | 10.31 |
| 80.00 | 4.67 | 18.03 | 3.10 | 8.97 | 4 | 35.86 | sum | | 9.41 |
| 81.00 | 1.84 | 15.86 | 2.66 | 8.05 | 1 | 8.05 | 609.44 | 203.15 | 8.51 |
| 81.67 | 0.00 | 14.20 | 2.37 | 7.44 | | | | 5.16 | 5.16 |
| 82.00 | 0.00 | 13.50 | 2.25 | 7.07 | 1 | 7.07 | | 2.42 | 2.42 |
| 83.00 | 0.00 | 10.50 | 1.75 | 5.50 | 4 | 21.99 | Simpson | | 6.28 |
| 84.00 | 0.00 | 8.25 | 1.38 | 4.32 | 2 | 8.64 | 1/3 rd. | | 4.91 |
| 85.00 | 0.00 | 5.25 | 0.88 | 2.75 | 4 | 11.00 | sum | | 3.53 |
| 86.00 | 0.00 | 3.00 | 0.50 | 1.57 | 1 | 1.57 | 50.27 | 16.76 | 2.16 |
| 87.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | 0.79 | 0.79 |
| | | | | Total Surface Area of AREA 8 = | | | | 535.74 | |
| | | | | Trapezoidal Strip Area Check | | | | | 535.71 |

**Table 10.** Calculation of Wetted Surface Area Eight.

# APPENDIX B. RESISTANCE CALCULATIONS

## A. ITTC SINGLE LENGTH METHOD

This Table shows the spreadsheet analysis for the ITTC single length method.

| Model Velocity (fps) | Model Froude # | Model Total Drag RTm (lbf.) | Model Total CTm | Model Reynolds # L = 11.75' | Model ITTC CFm | Model Friction RFm (lbf.) | Model Residual CRm | Model Residual RRm (lbf.) |
|---|---|---|---|---|---|---|---|---|
| 2.99 | 0.15 | 5 | 9.91E-03 | 3251745 | 3.68E-03 | 1.86 | 6.23E-03 | 3.14 |
| 3.27 | 0.17 | 5 | 8.29E-03 | 3556256 | 3.62E-03 | 2.19 | 4.66E-03 | 2.81 |
| 3.58 | 0.18 | 6 | 8.30E-03 | 3893393 | 3.56E-03 | 2.57 | 4.74E-03 | 3.43 |
| 3.88 | 0.20 | 7 | 8.24E-03 | 4219655 | 3.51E-03 | 2.98 | 4.73E-03 | 4.02 |
| 4.17 | 0.21 | 15 | 1.53E-02 | 4535042 | 3.46E-03 | 3.39 | 1.18E-02 | 11.61 |
| 4.47 | 0.23 | 24 | 2.13E-02 | 4861304 | 3.41E-03 | 3.85 | 1.79E-02 | 20.15 |
| 4.78 | 0.25 | 20 | 1.55E-02 | 5198441 | 3.37E-03 | 4.35 | 1.21E-02 | 15.65 |
| 5.08 | 0.26 | 25 | 1.72E-02 | 5524703 | 3.33E-03 | 4.86 | 1.38E-02 | 20.14 |
| 5.22 | 0.27 | 34 | 2.21E-02 | 5676959 | 3.32E-03 | 5.10 | 1.88E-02 | 28.90 |
| 5.37 | 0.28 | 46 | 2.83E-02 | 5840090 | 3.30E-03 | 5.37 | 2.50E-02 | 40.63 |
| 5.52 | 0.28 | 60 | 3.49E-02 | 6003221 | 3.28E-03 | 5.65 | 3.16E-02 | 54.35 |
| 5.67 | 0.29 | 73 | 4.02E-02 | 6166352 | 3.27E-03 | 5.93 | 3.70E-02 | 67.07 |
| 5.82 | 0.30 | 83 | 4.34E-02 | 6329483 | 3.25E-03 | 6.22 | 4.02E-02 | 76.78 |
| 5.97 | 0.31 | 90 | 4.47E-02 | 6492614 | 3.24E-03 | 6.51 | 4.15E-02 | 83.49 |
| 6.11 | 0.32 | 94 | 4.46E-02 | 6644870 | 3.22E-03 | 6.79 | 4.14E-02 | 87.21 |
| 6.26 | 0.32 | 95 | 4.30E-02 | 6808001 | 3.21E-03 | 7.10 | 3.97E-02 | 87.90 |
| 6.57 | 0.34 | 91 | 3.74E-02 | 7145138 | 3.18E-03 | 7.75 | 3.42E-02 | 83.25 |
| 6.87 | 0.35 | 83 | 3.12E-02 | 7471400 | 3.16E-03 | 8.41 | 2.80E-02 | 74.59 |
| 7.16 | 0.37 | 75 | 2.59E-02 | 7786787 | 3.13E-03 | 9.07 | 2.28E-02 | 65.93 |
| 7.46 | 0.38 | 67 | 2.13E-02 | 8113049 | 3.11E-03 | 9.77 | 1.82E-02 | 57.23 |
| 7.76 | 0.40 | 62 | 1.82E-02 | 8439311 | 3.09E-03 | 10.50 | 1.52E-02 | 51.50 |
| 8.05 | 0.42 | 58 | 1.59E-02 | 8754697 | 3.07E-03 | 11.23 | 1.28E-02 | 46.77 |
| 8.35 | 0.43 | 56 | 1.42E-02 | 9080959 | 3.05E-03 | 12.00 | 1.12E-02 | 44.00 |
| 8.95 | 0.46 | 55 | 1.22E-02 | 9733483 | 3.01E-03 | 13.63 | 9.15E-03 | 41.37 |
| 9.55 | 0.49 | 56 | 1.09E-02 | 10386007 | 2.98E-03 | 15.34 | 7.90E-03 | 40.66 |
| 10.14 | 0.52 | 58 | 1.00E-02 | 11027656 | 2.95E-03 | 17.12 | 7.05E-03 | 40.88 |
| 10.73 | 0.55 | 60 | 9.23E-03 | 11669305 | 2.92E-03 | 18.98 | 6.31E-03 | 41.02 |
| 11.34 | 0.58 | 63 | 8.68E-03 | 12332704 | 2.89E-03 | 21.00 | 5.79E-03 | 42.00 |
| 11.93 | 0.62 | 67 | 8.34E-03 | 12974353 | 2.87E-03 | 23.04 | 5.47E-03 | 43.96 |
| 12.52 | 0.65 | 70 | 7.91E-03 | 13616001 | 2.85E-03 | 25.17 | 5.07E-03 | 44.83 |
| 13.13 | 0.68 | 75 | 7.71E-03 | 14279401 | 2.82E-03 | 27.46 | 4.89E-03 | 47.54 |
| 14.33 | 0.74 | 84 | 7.25E-03 | 15584449 | 2.78E-03 | 32.23 | 4.47E-03 | 51.77 |
| 15.51 | 0.80 | 93 | 6.85E-03 | 16867746 | 2.75E-03 | 37.27 | 4.11E-03 | 55.73 |
| 16.71 | 0.86 | 103 | 6.54E-03 | 18172794 | 2.71E-03 | 42.73 | 3.82E-03 | 60.27 |
| 17.91 | 0.92 | 113 | 6.24E-03 | 19477842 | 2.68E-03 | 48.53 | 3.56E-03 | 64.47 |
| 19.09 | 0.98 | 123 | 5.98E-03 | 20761139 | 2.65E-03 | 54.56 | 3.33E-03 | 68.44 |
| 20.29 | 1.05 | 135 | 5.81E-03 | 22066187 | 2.63E-03 | 61.02 | 3.18E-03 | 73.98 |
| 21.49 | 1.11 | 147 | 5.64E-03 | 23371235 | 2.60E-03 | 67.82 | 3.04E-03 | 79.18 |
| 22.68 | 1.17 | 161 | 5.55E-03 | 24665408 | 2.58E-03 | 74.88 | 2.97E-03 | 86.12 |
| 23.87 | 1.23 | 174 | 5.41E-03 | 25959581 | 2.56E-03 | 82.27 | 2.85E-03 | 91.73 |

**Table 11.** ITTC resistance calculations for a single length analysis of the SLICE.

| Ship Velocity (fps) | Ship Velocity (kts.) | Ship Froude # | Ship Reynolds # L = 94' | Ship ITTC CFs | Ship Friction RFs (lbf.) | Ship Residual CRs = CRm | Ship Residual RRs (lbf.) | Ship Allowance CA | Ship Allowance RAs (lbf.) |
|---|---|---|---|---|---|---|---|---|---|
| 8.46 | 5.01 | 0.15 | 62150743 | 2.23E-03 | 593 | 6.23E-03 | 1653 | 0.0005 | 133 |
| 9.25 | 5.48 | 0.17 | 67970880 | 2.20E-03 | 700 | 4.66E-03 | 1481 | 0.0005 | 159 |
| 10.13 | 6.00 | 0.18 | 74414602 | 2.18E-03 | 828 | 4.74E-03 | 1803 | 0.0005 | 190 |
| 10.97 | 6.50 | 0.2 | 80650463 | 2.15E-03 | 961 | 4.73E-03 | 2116 | 0.0005 | 224 |
| 11.79 | 6.98 | 0.21 | 86678461 | 2.13E-03 | 1098 | 1.18E-02 | 6107 | 0.0005 | 258 |
| 12.64 | 7.49 | 0.23 | 92914322 | 2.11E-03 | 1249 | 1.79E-02 | 10603 | 0.0005 | 297 |
| 13.52 | 8.01 | 0.25 | 99358045 | 2.09E-03 | 1415 | 1.21E-02 | 8236 | 0.0005 | 339 |
| 14.37 | 8.51 | 0.26 | 105593905 | 2.07E-03 | 1584 | 1.38E-02 | 10600 | 0.0005 | 383 |
| 14.76 | 8.74 | 0.27 | 108503973 | 2.06E-03 | 1666 | 1.88E-02 | 15206 | 0.0005 | 405 |
| 15.19 | 8.99 | 0.28 | 111621904 | 2.05E-03 | 1756 | 2.50E-02 | 21379 | 0.0005 | 428 |
| 15.61 | 9.24 | 0.28 | 114739834 | 2.04E-03 | 1848 | 3.16E-02 | 28601 | 0.0005 | 452 |
| 16.04 | 9.50 | 0.29 | 117857764 | 2.03E-03 | 1943 | 3.70E-02 | 35293 | 0.0005 | 477 |
| 16.46 | 9.75 | 0.3 | 120975694 | 2.03E-03 | 2039 | 4.02E-02 | 40404 | 0.0005 | 503 |
| 16.89 | 10.00 | 0.31 | 124093625 | 2.02E-03 | 2138 | 4.15E-02 | 43932 | 0.0005 | 529 |
| 17.28 | 10.23 | 0.32 | 127003693 | 2.01E-03 | 2232 | 4.14E-02 | 45890 | 0.0005 | 554 |
| 17.71 | 10.48 | 0.32 | 130121623 | 2.01E-03 | 2335 | 3.97E-02 | 46254 | 0.0005 | 582 |
| 18.58 | 11.00 | 0.34 | 136565346 | 1.99E-03 | 2554 | 3.42E-02 | 43806 | 0.0005 | 641 |
| 19.43 | 11.51 | 0.35 | 142801206 | 1.98E-03 | 2775 | 2.80E-02 | 39250 | 0.0005 | 701 |
| 20.25 | 11.99 | 0.37 | 148829205 | 1.97E-03 | 2997 | 2.28E-02 | 34694 | 0.0005 | 761 |
| 21.10 | 12.49 | 0.38 | 155065065 | 1.96E-03 | 3235 | 1.82E-02 | 30114 | 0.0005 | 826 |
| 21.95 | 13.00 | 0.4 | 161300926 | 1.95E-03 | 3481 | 1.52E-02 | 27099 | 0.0005 | 894 |
| 22.77 | 13.48 | 0.42 | 167328924 | 1.94E-03 | 3727 | 1.28E-02 | 24612 | 0.0005 | 962 |
| 23.62 | 13.98 | 0.43 | 173564785 | 1.93E-03 | 3989 | 1.12E-02 | 23151 | 0.0005 | 1035 |
| 25.31 | 14.99 | 0.46 | 186036506 | 1.91E-03 | 4539 | 9.15E-03 | 21772 | 0.0005 | 1189 |
| 27.01 | 15.99 | 0.49 | 198508227 | 1.89E-03 | 5122 | 7.90E-03 | 21396 | 0.0005 | 1354 |
| 28.68 | 16.98 | 0.52 | 210772086 | 1.88E-03 | 5727 | 7.05E-03 | 21514 | 0.0005 | 1527 |
| 30.35 | 17.97 | 0.55 | 223035945 | 1.86E-03 | 6363 | 6.31E-03 | 21585 | 0.0005 | 1710 |
| 32.07 | 18.99 | 0.58 | 235715528 | 1.85E-03 | 7054 | 5.79E-03 | 22101 | 0.0005 | 1910 |
| 33.74 | 19.98 | 0.62 | 247979387 | 1.83E-03 | 7753 | 5.47E-03 | 23131 | 0.0005 | 2113 |
| 35.41 | 20.97 | 0.65 | 260243246 | 1.82E-03 | 8483 | 5.07E-03 | 23590 | 0.0005 | 2328 |
| 37.14 | 21.99 | 0.68 | 272922829 | 1.81E-03 | 9270 | 4.89E-03 | 25015 | 0.0005 | 2560 |
| 40.53 | 24.00 | 0.74 | 297866272 | 1.79E-03 | 10913 | 4.47E-03 | 27240 | 0.0005 | 3049 |
| 43.87 | 25.98 | 0.8 | 322393990 | 1.77E-03 | 12649 | 4.11E-03 | 29328 | 0.0005 | 3572 |
| 47.26 | 27.98 | 0.86 | 347337432 | 1.75E-03 | 14537 | 3.82E-03 | 31717 | 0.0005 | 4146 |
| 50.66 | 29.99 | 0.92 | 372280874 | 1.74E-03 | 16548 | 3.56E-03 | 33928 | 0.0005 | 4763 |
| 53.99 | 31.97 | 0.98 | 396808592 | 1.72E-03 | 18642 | 3.33E-03 | 36016 | 0.0005 | 5411 |
| 57.39 | 33.98 | 1.05 | 421752034 | 1.71E-03 | 20892 | 3.18E-03 | 38928 | 0.0005 | 6113 |
| 60.78 | 35.99 | 1.11 | 446695476 | 1.70E-03 | 23260 | 3.04E-03 | 41666 | 0.0005 | 6858 |
| 64.15 | 37.98 | 1.17 | 471431056 | 1.68E-03 | 25726 | 2.97E-03 | 45316 | 0.0005 | 7638 |
| 67.51 | 39.98 | 1.23 | 496166636 | 1.67E-03 | 28308 | 2.85E-03 | 48271 | 0.0005 | 8461 |

**Table 11**. ITTC resistance calculations for a single length analysis of the SLICE.

| Ship Total CTs | Ship Total Resistance RTs (lbf.) | Ship EHP (hp) | Ship SHP (hp) |
|---|---|---|---|
| 8.96E-03 | 2379 | 37 | 50 |
| 7.37E-03 | 2340 | 39 | 54 |
| 7.41E-03 | 2821 | 52 | 71 |
| 7.38E-03 | 3301 | 66 | 90 |
| 1.45E-02 | 7464 | 160 | 219 |
| 2.05E-02 | 12149 | 279 | 383 |
| 1.47E-02 | 9990 | 246 | 336 |
| 1.64E-02 | 12567 | 328 | 450 |
| 2.14E-02 | 17277 | 464 | 635 |
| 2.75E-02 | 23563 | 651 | 891 |
| 3.41E-02 | 30902 | 877 | 1202 |
| 3.95E-02 | 37713 | 1100 | 1506 |
| 4.27E-02 | 42946 | 1285 | 1761 |
| 4.40E-02 | 46599 | 1431 | 1960 |
| 4.39E-02 | 48676 | 1529 | 2095 |
| 4.23E-02 | 49171 | 1583 | 2168 |
| 3.67E-02 | 47001 | 1588 | 2175 |
| 3.05E-02 | 42726 | 1510 | 2068 |
| 2.53E-02 | 38452 | 1416 | 1940 |
| 2.07E-02 | 34175 | 1311 | 1796 |
| 1.76E-02 | 31474 | 1256 | 1721 |
| 1.52E-02 | 29300 | 1213 | 1662 |
| 1.36E-02 | 28176 | 1210 | 1657 |
| 1.16E-02 | 27500 | 1266 | 1734 |
| 1.03E-02 | 27872 | 1369 | 1875 |
| 9.42E-03 | 28768 | 1500 | 2055 |
| 8.67E-03 | 29658 | 1637 | 2242 |
| 8.13E-03 | 31064 | 1812 | 2482 |
| 7.81E-03 | 32998 | 2024 | 2773 |
| 7.39E-03 | 34401 | 2215 | 3034 |
| 7.20E-03 | 36845 | 2488 | 3408 |
| 6.76E-03 | 41202 | 3036 | 4159 |
| 6.38E-03 | 45549 | 3633 | 4977 |
| 6.08E-03 | 50401 | 4331 | 5933 |
| 5.80E-03 | 55238 | 5088 | 6969 |
| 5.55E-03 | 60070 | 5897 | 8078 |
| 5.39E-03 | 65933 | 6880 | 9424 |
| 5.23E-03 | 71784 | 7933 | 10867 |
| 5.15E-03 | 78680 | 9177 | 12571 |
| 5.03E-03 | 85039 | 10439 | 14300 |

**Table 11**. ITTC resistance calculations for a single length analysis of the SLICE.

## B. ITTC SECTIONALIZED HULL METHOD

This Table shows the spreadsheet analysis for the ITTC sectionalized hull method.

| Model | Model | Model | Model | Reynolds #'s for Model Components Lengths | | | | Model ITTC Coefficients | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Velocity | Froude | Total Drag | Total | L=3.00' | L=3.00' | L=4.28175' | L=4.50' | CFm | | | |
| (fps) | # | RTm (lbf.) | CTm | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod |
| 2.99 | 0.15 | 5 | 9.91E-03 | 830233 | 830233 | 1167515 | 1245349 | 4.88E-03 | 4.88E-03 | 4.53E-03 | 4.47E-03 |
| 3.27 | 0.17 | 5 | 8.29E-03 | 907980 | 907980 | 1276847 | 1361970 | 4.79E-03 | 4.79E-03 | 4.45E-03 | 4.39E-03 |
| 3.58 | 0.18 | 6 | 8.30E-03 | 994058 | 994058 | 1397894 | 1491087 | 4.69E-03 | 4.69E-03 | 4.36E-03 | 4.31E-03 |
| 3.88 | 0.20 | 7 | 8.24E-03 | 1077359 | 1077359 | 1515036 | 1616038 | 4.61E-03 | 4.61E-03 | 4.29E-03 | 4.23E-03 |
| 4.17 | 0.21 | 15 | 1.53E-02 | 1157883 | 1157883 | 1628273 | 1736825 | 4.54E-03 | 4.54E-03 | 4.23E-03 | 4.17E-03 |
| 4.47 | 0.23 | 24 | 2.13E-02 | 1241184 | 1241184 | 1745415 | 1861776 | 4.48E-03 | 4.48E-03 | 4.17E-03 | 4.11E-03 |
| 4.78 | 0.25 | 20 | 1.55E-02 | 1327262 | 1327262 | 1866462 | 1990892 | 4.41E-03 | 4.41E-03 | 4.11E-03 | 4.06E-03 |
| 5.08 | 0.26 | 25 | 1.72E-02 | 1410563 | 1410563 | 1983604 | 2115844 | 4.36E-03 | 4.36E-03 | 4.06E-03 | 4.01E-03 |
| 5.22 | 0.27 | 34 | 2.21E-02 | 1449436 | 1449436 | 2038270 | 2174154 | 4.33E-03 | 4.33E-03 | 4.04E-03 | 3.99E-03 |
| 5.37 | 0.28 | 46 | 2.83E-02 | 1491087 | 1491087 | 2096841 | 2236630 | 4.31E-03 | 4.31E-03 | 4.02E-03 | 3.96E-03 |
| 5.52 | 0.28 | 60 | 3.49E-02 | 1532737 | 1532737 | 2155412 | 2299106 | 4.28E-03 | 4.28E-03 | 3.99E-03 | 3.94E-03 |
| 5.67 | 0.29 | 73 | 4.02E-02 | 1574388 | 1574388 | 2213983 | 2361582 | 4.26E-03 | 4.26E-03 | 3.97E-03 | 3.92E-03 |
| 5.82 | 0.30 | 83 | 4.34E-02 | 1616038 | 1616038 | 2272554 | 2424057 | 4.23E-03 | 4.23E-03 | 3.95E-03 | 3.90E-03 |
| 5.97 | 0.31 | 90 | 4.47E-02 | 1657689 | 1657689 | 2331125 | 2486533 | 4.21E-03 | 4.21E-03 | 3.93E-03 | 3.88E-03 |
| 6.11 | 0.32 | 94 | 4.46E-02 | 1696562 | 1696562 | 2385791 | 2544844 | 4.19E-03 | 4.19E-03 | 3.91E-03 | 3.86E-03 |
| 6.26 | 0.32 | 95 | 4.30E-02 | 1738213 | 1738213 | 2444362 | 2607319 | 4.17E-03 | 4.17E-03 | 3.89E-03 | 3.85E-03 |
| 6.57 | 0.34 | 91 | 3.74E-02 | 1824291 | 1824291 | 2565409 | 2736436 | 4.13E-03 | 4.13E-03 | 3.86E-03 | 3.81E-03 |
| 6.87 | 0.35 | 83 | 3.12E-02 | 1907591 | 1907591 | 2682551 | 2861387 | 4.09E-03 | 4.09E-03 | 3.82E-03 | 3.78E-03 |
| 7.16 | 0.37 | 75 | 2.59E-02 | 1988116 | 1988116 | 2795788 | 2982174 | 4.06E-03 | 4.06E-03 | 3.79E-03 | 3.75E-03 |
| 7.46 | 0.38 | 67 | 2.13E-02 | 2071417 | 2071417 | 2912930 | 3107125 | 4.03E-03 | 4.03E-03 | 3.76E-03 | 3.72E-03 |
| 7.76 | 0.40 | 62 | 1.82E-02 | 2154718 | 2154718 | 3030072 | 3232076 | 3.99E-03 | 3.99E-03 | 3.73E-03 | 3.69E-03 |
| 8.05 | 0.42 | 58 | 1.59E-02 | 2235242 | 2235242 | 3143309 | 3352863 | 3.96E-03 | 3.96E-03 | 3.71E-03 | 3.66E-03 |
| 8.35 | 0.43 | 56 | 1.42E-02 | 2318543 | 2318543 | 3260451 | 3477814 | 3.94E-03 | 3.94E-03 | 3.68E-03 | 3.64E-03 |
| 8.95 | 0.46 | 55 | 1.22E-02 | 2485145 | 2485145 | 3494735 | 3727717 | 3.88E-03 | 3.88E-03 | 3.63E-03 | 3.59E-03 |
| 9.55 | 0.49 | 56 | 1.09E-02 | 2651747 | 2651747 | 3729019 | 3977620 | 3.83E-03 | 3.83E-03 | 3.59E-03 | 3.55E-03 |
| 10.14 | 0.52 | 58 | 1.00E-02 | 2815572 | 2815572 | 3959398 | 4223358 | 3.79E-03 | 3.79E-03 | 3.55E-03 | 3.51E-03 |
| 10.73 | 0.55 | 60 | 9.23E-03 | 2979397 | 2979397 | 4189777 | 4469095 | 3.75E-03 | 3.75E-03 | 3.51E-03 | 3.47E-03 |
| 11.34 | 0.58 | 63 | 8.68E-03 | 3148775 | 3148775 | 4427966 | 4723163 | 3.71E-03 | 3.71E-03 | 3.47E-03 | 3.43E-03 |
| 11.93 | 0.62 | 67 | 8.34E-03 | 3312601 | 3312601 | 4658345 | 4968901 | 3.67E-03 | 3.67E-03 | 3.44E-03 | 3.40E-03 |
| 12.52 | 0.65 | 70 | 7.91E-03 | 3476426 | 3476426 | 4888724 | 5214639 | 3.64E-03 | 3.64E-03 | 3.41E-03 | 3.37E-03 |
| 13.13 | 0.68 | 75 | 7.71E-03 | 3645804 | 3645804 | 5126912 | 5468707 | 3.60E-03 | 3.60E-03 | 3.38E-03 | 3.34E-03 |
| 14.33 | 0.74 | 84 | 7.25E-03 | 3979008 | 3979008 | 5595480 | 5968512 | 3.54E-03 | 3.54E-03 | 3.33E-03 | 3.29E-03 |
| 15.51 | 0.80 | 93 | 6.85E-03 | 4306659 | 4306659 | 6056239 | 6459988 | 3.49E-03 | 3.49E-03 | 3.28E-03 | 3.24E-03 |
| 16.71 | 0.86 | 103 | 6.54E-03 | 4639862 | 4639862 | 6524806 | 6959793 | 3.44E-03 | 3.44E-03 | 3.24E-03 | 3.20E-03 |
| 17.91 | 0.92 | 113 | 6.24E-03 | 4973066 | 4973066 | 6993374 | 7459599 | 3.40E-03 | 3.40E-03 | 3.20E-03 | 3.16E-03 |
| 19.09 | 0.98 | 123 | 5.98E-03 | 5300716 | 5300716 | 7454132 | 7951075 | 3.36E-03 | 3.36E-03 | 3.16E-03 | 3.12E-03 |
| 20.29 | 1.05 | 135 | 5.81E-03 | 5633920 | 5633920 | 7922700 | 8450880 | 3.32E-03 | 3.32E-03 | 3.13E-03 | 3.09E-03 |
| 21.49 | 1.11 | 147 | 5.64E-03 | 5967124 | 5967124 | 8391268 | 8950686 | 3.29E-03 | 3.29E-03 | 3.09E-03 | 3.06E-03 |
| 22.68 | 1.17 | 161 | 5.55E-03 | 6297551 | 6297551 | 8855931 | 9446326 | 3.26E-03 | 3.26E-03 | 3.06E-03 | 3.03E-03 |
| 23.87 | 1.23 | 174 | 5.41E-03 | 6627978 | 6627978 | 9320594 | 9941967 | 3.23E-03 | 3.23E-03 | 3.04E-03 | 3.00E-03 |

**Table 12**. ITTC resistance calculations for a sectionalized hull analysis of the SLICE.

| Frictional Resistance of Model Components | | | | Summed | Equivalent | Model | Model | Model | Ship | Ship | Ship |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RFm (lbf.) | | | | Σ RFm | Frictional | Equivalent | Residual | Residual | Velocity | Velocity | Froude |
| Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | (lbf.) | CFm | Reynolds # | CRm | RRm (lbf.) | (fps) | (kts.) | # |
| 0.54 | 0.53 | 0.63 | 0.65 | 2.36 | 4.67E-03 | 1019427 | 5.24E-03 | 2.64 | 8.46 | 5.01 | 0.15 |
| 0.63 | 0.63 | 0.74 | 0.76 | 2.76 | 4.58E-03 | 1114953 | 3.71E-03 | 2.24 | 9.25 | 5.48 | 0.17 |
| 0.74 | 0.74 | 0.88 | 0.89 | 3.25 | 4.49E-03 | 1220719 | 3.80E-03 | 2.75 | 10.13 | 6.00 | 0.18 |
| 0.86 | 0.85 | 1.01 | 1.03 | 3.75 | 4.42E-03 | 1323077 | 3.82E-03 | 3.25 | 10.97 | 6.50 | 0.20 |
| 0.97 | 0.97 | 1.15 | 1.18 | 4.27 | 4.35E-03 | 1422026 | 1.09E-02 | 10.73 | 11.79 | 6.98 | 0.21 |
| 1.10 | 1.10 | 1.30 | 1.33 | 4.83 | 4.29E-03 | 1524391 | 1.70E-02 | 19.17 | 12.64 | 7.49 | 0.23 |
| 1.24 | 1.23 | 1.47 | 1.50 | 5.45 | 4.23E-03 | 1630171 | 1.13E-02 | 14.55 | 13.52 | 8.01 | 0.25 |
| 1.39 | 1.38 | 1.64 | 1.68 | 6.08 | 4.17E-03 | 1732542 | 1.30E-02 | 18.92 | 14.37 | 8.51 | 0.26 |
| 1.46 | 1.45 | 1.72 | 1.76 | 6.38 | 4.15E-03 | 1780316 | 1.80E-02 | 27.62 | 14.76 | 8.74 | 0.27 |
| 1.53 | 1.52 | 1.81 | 1.85 | 6.72 | 4.13E-03 | 1831503 | 2.41E-02 | 39.28 | 15.19 | 8.99 | 0.28 |
| 1.61 | 1.60 | 1.90 | 1.95 | 7.06 | 4.10E-03 | 1882691 | 3.08E-02 | 52.94 | 15.61 | 9.24 | 0.28 |
| 1.69 | 1.68 | 2.00 | 2.04 | 7.41 | 4.08E-03 | 1933879 | 3.62E-02 | 65.59 | 16.04 | 9.50 | 0.29 |
| 1.77 | 1.76 | 2.09 | 2.14 | 7.76 | 4.06E-03 | 1985068 | 3.94E-02 | 75.24 | 16.46 | 9.75 | 0.30 |
| 1.85 | 1.84 | 2.19 | 2.24 | 8.13 | 4.04E-03 | 2036258 | 4.07E-02 | 81.87 | 16.89 | 10.00 | 0.31 |
| 1.93 | 1.92 | 2.29 | 2.34 | 8.47 | 4.02E-03 | 2084035 | 4.06E-02 | 85.53 | 17.28 | 10.23 | 0.32 |
| 2.02 | 2.00 | 2.39 | 2.44 | 8.85 | 4.00E-03 | 2135225 | 3.90E-02 | 86.15 | 17.71 | 10.48 | 0.32 |
| 2.20 | 2.18 | 2.61 | 2.67 | 9.65 | 3.96E-03 | 2241021 | 3.34E-02 | 81.35 | 18.58 | 11.00 | 0.34 |
| 2.38 | 2.37 | 2.82 | 2.89 | 10.46 | 3.93E-03 | 2343405 | 2.72E-02 | 72.54 | 19.43 | 11.51 | 0.35 |
| 2.57 | 2.55 | 3.04 | 3.11 | 11.27 | 3.90E-03 | 2442379 | 2.20E-02 | 63.73 | 20.25 | 11.99 | 0.37 |
| 2.76 | 2.74 | 3.28 | 3.35 | 12.14 | 3.86E-03 | 2544767 | 1.75E-02 | 54.86 | 21.10 | 12.49 | 0.38 |
| 2.97 | 2.95 | 3.52 | 3.60 | 13.03 | 3.83E-03 | 2647157 | 1.44E-02 | 48.97 | 21.95 | 13.00 | 0.40 |
| 3.17 | 3.15 | 3.76 | 3.85 | 13.92 | 3.81E-03 | 2746135 | 1.21E-02 | 44.08 | 22.77 | 13.48 | 0.42 |
| 3.38 | 3.36 | 4.02 | 4.11 | 14.87 | 3.78E-03 | 2848528 | 1.05E-02 | 41.13 | 23.62 | 13.98 | 0.43 |
| 3.83 | 3.81 | 4.55 | 4.66 | 16.86 | 3.73E-03 | 3053319 | 8.44E-03 | 38.14 | 25.31 | 14.99 | 0.46 |
| 4.31 | 4.28 | 5.12 | 5.24 | 18.95 | 3.68E-03 | 3258115 | 7.20E-03 | 37.05 | 27.01 | 15.99 | 0.49 |
| 4.80 | 4.77 | 5.71 | 5.84 | 21.12 | 3.64E-03 | 3459502 | 6.35E-03 | 36.88 | 28.68 | 16.98 | 0.52 |
| 5.32 | 5.28 | 6.32 | 6.47 | 23.40 | 3.60E-03 | 3660894 | 5.63E-03 | 36.60 | 30.35 | 17.97 | 0.55 |
| 5.88 | 5.84 | 6.99 | 7.16 | 25.86 | 3.56E-03 | 3869118 | 5.12E-03 | 37.14 | 32.07 | 18.99 | 0.58 |
| 6.44 | 6.40 | 7.66 | 7.85 | 28.35 | 3.53E-03 | 4070519 | 4.81E-03 | 38.65 | 33.74 | 19.98 | 0.62 |
| 7.03 | 6.98 | 8.36 | 8.57 | 30.94 | 3.50E-03 | 4271923 | 4.42E-03 | 39.06 | 35.41 | 20.97 | 0.65 |
| 7.66 | 7.61 | 9.12 | 9.34 | 33.73 | 3.47E-03 | 4480158 | 4.24E-03 | 41.27 | 37.14 | 21.99 | 0.68 |
| 8.98 | 8.91 | 10.69 | 10.95 | 39.53 | 3.41E-03 | 4889812 | 3.84E-03 | 44.47 | 40.53 | 24.00 | 0.74 |
| 10.36 | 10.29 | 12.34 | 12.64 | 45.63 | 3.36E-03 | 5292651 | 3.49E-03 | 47.37 | 43.87 | 25.98 | 0.80 |
| 11.86 | 11.78 | 14.13 | 14.48 | 52.25 | 3.32E-03 | 5702329 | 3.22E-03 | 50.75 | 47.26 | 27.98 | 0.86 |
| 13.45 | 13.36 | 16.04 | 16.43 | 59.27 | 3.27E-03 | 6112018 | 2.97E-03 | 53.73 | 50.66 | 29.99 | 0.92 |
| 15.10 | 15.00 | 18.01 | 18.45 | 66.56 | 3.24E-03 | 6514887 | 2.74E-03 | 56.44 | 53.99 | 31.97 | 0.98 |
| 16.87 | 16.75 | 20.13 | 20.62 | 74.37 | 3.20E-03 | 6924595 | 2.61E-03 | 60.63 | 57.39 | 33.98 | 1.05 |
| 18.73 | 18.60 | 22.35 | 22.90 | 82.58 | 3.17E-03 | 7334310 | 2.47E-03 | 64.42 | 60.78 | 35.99 | 1.11 |
| 20.65 | 20.51 | 24.66 | 25.27 | 91.10 | 3.14E-03 | 7740620 | 2.41E-03 | 69.90 | 64.15 | 37.98 | 1.17 |
| 22.67 | 22.51 | 27.07 | 27.74 | 100.00 | 3.11E-03 | 8146936 | 2.30E-03 | 74.00 | 67.51 | 39.98 | 1.23 |

**Table 12.** ITTC resistance calculations for a sectionalized hull analysis of the SLICE.

| Reynolds #'s for Ship Components Lengths | | | | Ship ITTC Coefficients | | | | Frictional Resistance of Ship Components | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L=24.00' | L=24.00' | L=33.75' | L=36.00' | CFs | | | | RFs (lbf.) | | | |
| Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod |
| 15868275 | 15868275 | 22314762 | 23802412 | 2.77E-03 | 2.77E-03 | 2.62E-03 | 2.59E-03 | 161 | 160 | 193 | 198 |
| 17354267 | 17354267 | 24404438 | 26031401 | 2.73E-03 | 2.73E-03 | 2.58E-03 | 2.56E-03 | 190 | 188 | 227 | 233 |
| 18999473 | 18999473 | 26718009 | 28499209 | 2.69E-03 | 2.69E-03 | 2.55E-03 | 2.52E-03 | 224 | 222 | 269 | 276 |
| 20591608 | 20591608 | 28956948 | 30887411 | 2.66E-03 | 2.66E-03 | 2.51E-03 | 2.49E-03 | 259 | 258 | 312 | 320 |
| 22130671 | 22130671 | 31121256 | 33196007 | 2.63E-03 | 2.63E-03 | 2.49E-03 | 2.46E-03 | 296 | 294 | 356 | 365 |
| 23722806 | 23722806 | 33360195 | 35584208 | 2.60E-03 | 2.60E-03 | 2.46E-03 | 2.43E-03 | 337 | 334 | 404 | 415 |
| 25368011 | 25368011 | 35673766 | 38052017 | 2.57E-03 | 2.57E-03 | 2.43E-03 | 2.41E-03 | 381 | 378 | 458 | 470 |
| 26960146 | 26960146 | 37912705 | 40440219 | 2.54E-03 | 2.54E-03 | 2.41E-03 | 2.39E-03 | 426 | 423 | 512 | 525 |
| 27703142 | 27703142 | 38957544 | 41554713 | 2.53E-03 | 2.53E-03 | 2.40E-03 | 2.38E-03 | 448 | 445 | 538 | 552 |
| 28499209 | 28499209 | 40077013 | 42748814 | 2.52E-03 | 2.52E-03 | 2.39E-03 | 2.37E-03 | 472 | 468 | 567 | 582 |
| 29295277 | 29295277 | 41196483 | 43942915 | 2.51E-03 | 2.51E-03 | 2.38E-03 | 2.36E-03 | 496 | 493 | 597 | 612 |
| 30091344 | 30091344 | 42315953 | 45137016 | 2.50E-03 | 2.50E-03 | 2.37E-03 | 2.35E-03 | 521 | 518 | 627 | 643 |
| 30887411 | 30887411 | 43435422 | 46331117 | 2.49E-03 | 2.49E-03 | 2.36E-03 | 2.34E-03 | 547 | 543 | 658 | 675 |
| 31683479 | 31683479 | 44554892 | 47525218 | 2.48E-03 | 2.48E-03 | 2.35E-03 | 2.33E-03 | 573 | 569 | 690 | 708 |
| 32426475 | 32426475 | 45599730 | 48639712 | 2.47E-03 | 2.47E-03 | 2.34E-03 | 2.32E-03 | 598 | 594 | 720 | 739 |
| 33222542 | 33222542 | 46719200 | 49833813 | 2.46E-03 | 2.46E-03 | 2.33E-03 | 2.31E-03 | 626 | 621 | 753 | 773 |
| 34867748 | 34867748 | 49032770 | 52301622 | 2.44E-03 | 2.44E-03 | 2.32E-03 | 2.29E-03 | 684 | 679 | 823 | 845 |
| 36459882 | 36459882 | 51271710 | 54689824 | 2.42E-03 | 2.42E-03 | 2.30E-03 | 2.28E-03 | 743 | 737 | 894 | 917 |
| 37998946 | 37998946 | 53436018 | 56998419 | 2.41E-03 | 2.41E-03 | 2.29E-03 | 2.26E-03 | 801 | 796 | 965 | 990 |
| 39591080 | 39591080 | 55674957 | 59386621 | 2.39E-03 | 2.39E-03 | 2.27E-03 | 2.25E-03 | 864 | 858 | 1041 | 1068 |
| 41183215 | 41183215 | 57913896 | 61774823 | 2.38E-03 | 2.38E-03 | 2.26E-03 | 2.24E-03 | 930 | 923 | 1120 | 1149 |
| 42722279 | 42722279 | 60078204 | 64083418 | 2.37E-03 | 2.37E-03 | 2.25E-03 | 2.22E-03 | 995 | 988 | 1198 | 1230 |
| 44314413 | 44314413 | 62317144 | 66471620 | 2.35E-03 | 2.35E-03 | 2.23E-03 | 2.21E-03 | 1064 | 1057 | 1282 | 1316 |
| 47498682 | 47498682 | 66795022 | 71248024 | 2.33E-03 | 2.33E-03 | 2.21E-03 | 2.19E-03 | 1210 | 1201 | 1458 | 1496 |
| 50682952 | 50682952 | 71272901 | 76024427 | 2.30E-03 | 2.30E-03 | 2.19E-03 | 2.17E-03 | 1364 | 1354 | 1644 | 1687 |
| 53814150 | 53814150 | 75676148 | 80721224 | 2.28E-03 | 2.28E-03 | 2.17E-03 | 2.15E-03 | 1524 | 1513 | 1837 | 1886 |
| 56945348 | 56945348 | 80079395 | 85418022 | 2.26E-03 | 2.26E-03 | 2.15E-03 | 2.13E-03 | 1692 | 1680 | 2040 | 2094 |
| 60182688 | 60182688 | 84631905 | 90274032 | 2.25E-03 | 2.25E-03 | 2.13E-03 | 2.11E-03 | 1874 | 1861 | 2260 | 2320 |
| 63313886 | 63313886 | 89035152 | 94970829 | 2.23E-03 | 2.23E-03 | 2.12E-03 | 2.10E-03 | 2058 | 2044 | 2483 | 2549 |
| 66445084 | 66445084 | 93438400 | 99667626 | 2.21E-03 | 2.21E-03 | 2.10E-03 | 2.08E-03 | 2250 | 2235 | 2715 | 2788 |
| 69682425 | 69682425 | 97990909 | 104523637 | 2.20E-03 | 2.20E-03 | 2.09E-03 | 2.07E-03 | 2457 | 2441 | 2965 | 3045 |
| 76050963 | 76050963 | 106946667 | 114076444 | 2.17E-03 | 2.17E-03 | 2.06E-03 | 2.04E-03 | 2889 | 2870 | 3488 | 3582 |
| 82313359 | 82313359 | 115753161 | 123470039 | 2.14E-03 | 2.14E-03 | 2.04E-03 | 2.02E-03 | 3346 | 3323 | 4040 | 4149 |
| 88681897 | 88681897 | 124708918 | 133022846 | 2.12E-03 | 2.12E-03 | 2.02E-03 | 2.00E-03 | 3841 | 3815 | 4639 | 4765 |
| 95050436 | 95050436 | 133664675 | 142575654 | 2.10E-03 | 2.10E-03 | 2.00E-03 | 1.98E-03 | 4368 | 4338 | 5277 | 5420 |
| 101312832 | 101312832 | 142471170 | 151969248 | 2.08E-03 | 2.08E-03 | 1.98E-03 | 1.96E-03 | 4917 | 4884 | 5942 | 6103 |
| 107681370 | 107681370 | 151426927 | 161522056 | 2.06E-03 | 2.06E-03 | 1.96E-03 | 1.95E-03 | 5506 | 5469 | 6655 | 6835 |
| 114049909 | 114049909 | 160382684 | 171074863 | 2.04E-03 | 2.04E-03 | 1.95E-03 | 1.93E-03 | 6126 | 6084 | 7405 | 7606 |
| 120365376 | 120365376 | 169263810 | 180548064 | 2.03E-03 | 2.03E-03 | 1.93E-03 | 1.92E-03 | 6771 | 6724 | 8186 | 8409 |
| 126680843 | 126680843 | 178144936 | 190021265 | 2.01E-03 | 2.01E-03 | 1.92E-03 | 1.90E-03 | 7446 | 7395 | 9004 | 9249 |

**Table 12**. ITTC resistance calculations for a sectionalized hull analysis of the SLICE.

| Summed Σ RFs (lbf.) | Equivalent Frictional CFs | Ship Equivalent Reynolds # | Ship Residual CRs | Ship Residual RRs (lbf.) | Ship Allowance CA | Ship Allowance RAs (lbf.) | Ship Total CTs | Ship Total Resistance RTs (lbf.) | Ship EHP (hp) | Ship SHP (hp) |
|---|---|---|---|---|---|---|---|---|---|---|
| 711 | 2.68E-03 | 19511395 | 5.24E-03 | 1392 | 0.0005 | 133 | 8.42E-03 | 2236 | 34 | 47 |
| 839 | 2.64E-03 | 21339224 | 3.71E-03 | 1177 | 0.0005 | 159 | 6.85E-03 | 2175 | 37 | 50 |
| 990 | 2.60E-03 | 23362945 | 3.80E-03 | 1448 | 0.0005 | 190 | 6.91E-03 | 2629 | 48 | 66 |
| 1148 | 2.57E-03 | 25321433 | 3.82E-03 | 1710 | 0.0005 | 224 | 6.89E-03 | 3082 | 61 | 84 |
| 1311 | 2.54E-03 | 27214680 | 1.09E-02 | 5648 | 0.0005 | 258 | 1.40E-02 | 7217 | 155 | 212 |
| 1490 | 2.51E-03 | 29173250 | 1.70E-02 | 10086 | 0.0005 | 297 | 2.00E-02 | 11873 | 273 | 374 |
| 1686 | 2.48E-03 | 31197144 | 1.13E-02 | 7656 | 0.0005 | 339 | 1.43E-02 | 9681 | 238 | 326 |
| 1886 | 2.46E-03 | 33155786 | 1.30E-02 | 9956 | 0.0005 | 383 | 1.60E-02 | 12226 | 319 | 438 |
| 1983 | 2.45E-03 | 34069830 | 1.80E-02 | 14532 | 0.0005 | 405 | 2.09E-02 | 16920 | 454 | 622 |
| 2089 | 2.44E-03 | 35049170 | 2.41E-02 | 20672 | 0.0005 | 428 | 2.71E-02 | 23189 | 640 | 877 |
| 2198 | 2.43E-03 | 36028518 | 3.08E-02 | 27859 | 0.0005 | 452 | 3.37E-02 | 30510 | 866 | 1186 |
| 2309 | 2.42E-03 | 37007873 | 3.62E-02 | 34517 | 0.0005 | 477 | 3.91E-02 | 37304 | 1088 | 1490 |
| 2423 | 2.41E-03 | 37987235 | 3.94E-02 | 39592 | 0.0005 | 503 | 4.23E-02 | 42518 | 1273 | 1743 |
| 2540 | 2.40E-03 | 38966604 | 4.07E-02 | 43084 | 0.0005 | 529 | 4.36E-02 | 46153 | 1417 | 1941 |
| 2651 | 2.39E-03 | 39880688 | 4.06E-02 | 45007 | 0.0005 | 554 | 4.35E-02 | 48212 | 1515 | 2075 |
| 2772 | 2.38E-03 | 40860069 | 3.90E-02 | 45335 | 0.0005 | 582 | 4.18E-02 | 48689 | 1567 | 2147 |
| 3031 | 2.36E-03 | 42884144 | 3.34E-02 | 42806 | 0.0005 | 641 | 3.63E-02 | 46478 | 1570 | 2151 |
| 3291 | 2.35E-03 | 44842950 | 2.72E-02 | 38171 | 0.0005 | 701 | 3.01E-02 | 42163 | 1490 | 2041 |
| 3552 | 2.33E-03 | 46736484 | 2.20E-02 | 33536 | 0.0005 | 761 | 2.49E-02 | 37849 | 1394 | 1909 |
| 3832 | 2.32E-03 | 48695334 | 1.75E-02 | 28871 | 0.0005 | 826 | 2.03E-02 | 33529 | 1286 | 1762 |
| 4122 | 2.30E-03 | 50654204 | 1.44E-02 | 25769 | 0.0005 | 894 | 1.72E-02 | 30785 | 1229 | 1683 |
| 4411 | 2.29E-03 | 52547797 | 1.21E-02 | 23195 | 0.0005 | 962 | 1.48E-02 | 28568 | 1183 | 1620 |
| 4719 | 2.28E-03 | 54506705 | 1.05E-02 | 21642 | 0.0005 | 1035 | 1.32E-02 | 27397 | 1176 | 1612 |
| 5365 | 2.26E-03 | 58424574 | 8.44E-03 | 20072 | 0.0005 | 1189 | 1.12E-02 | 26626 | 1226 | 1679 |
| 6050 | 2.23E-03 | 62342510 | 7.20E-03 | 19494 | 0.0005 | 1354 | 9.93E-03 | 26898 | 1321 | 1810 |
| 6759 | 2.21E-03 | 66195208 | 6.35E-03 | 19405 | 0.0005 | 1527 | 9.07E-03 | 27691 | 1444 | 1978 |
| 7505 | 2.19E-03 | 70047962 | 5.63E-03 | 19260 | 0.0005 | 1710 | 8.33E-03 | 28475 | 1571 | 2152 |
| 8314 | 2.18E-03 | 74031372 | 5.12E-03 | 19543 | 0.0005 | 1910 | 7.79E-03 | 29766 | 1736 | 2378 |
| 9133 | 2.16E-03 | 77884230 | 4.81E-03 | 20338 | 0.0005 | 2113 | 7.47E-03 | 31585 | 1938 | 2654 |
| 9988 | 2.15E-03 | 81737133 | 4.42E-03 | 20553 | 0.0005 | 2328 | 7.06E-03 | 32869 | 2116 | 2899 |
| 10908 | 2.13E-03 | 85720690 | 4.24E-03 | 21718 | 0.0005 | 2560 | 6.87E-03 | 35186 | 2376 | 3255 |
| 12829 | 2.10E-03 | 93557324 | 3.84E-03 | 23403 | 0.0005 | 3049 | 6.44E-03 | 39280 | 2895 | 3965 |
| 14857 | 2.08E-03 | 101263501 | 3.49E-03 | 24925 | 0.0005 | 3572 | 6.07E-03 | 43354 | 3458 | 4737 |
| 17060 | 2.06E-03 | 109100432 | 3.22E-03 | 26706 | 0.0005 | 4146 | 5.78E-03 | 47913 | 4117 | 5640 |
| 19404 | 2.04E-03 | 116937495 | 2.97E-03 | 28274 | 0.0005 | 4763 | 5.50E-03 | 52442 | 4830 | 6617 |
| 21845 | 2.02E-03 | 124644059 | 2.74E-03 | 29698 | 0.0005 | 5411 | 5.26E-03 | 56955 | 5591 | 7659 |
| 24465 | 2.00E-03 | 132481354 | 2.61E-03 | 31903 | 0.0005 | 6113 | 5.11E-03 | 62481 | 6519 | 8931 |
| 27222 | 1.98E-03 | 140318755 | 2.47E-03 | 33901 | 0.0005 | 6858 | 4.96E-03 | 67980 | 7513 | 10291 |
| 30091 | 1.97E-03 | 148090943 | 2.41E-03 | 36784 | 0.0005 | 7638 | 4.88E-03 | 74513 | 8691 | 11905 |
| 33092 | 1.96E-03 | 155863222 | 2.30E-03 | 38942 | 0.0005 | 8461 | 4.76E-03 | 80495 | 9881 | 13536 |

**Table 12**. ITTC resistance calculations for a sectionalized hull analysis of the SLICE.

## C. HUGHES SECTIONALIZED HULL METHOD

This Table shows the spreadsheet analysis for the Hughes sectionalized hull method.

| Model | Model | Model | Model | Reynolds #'s for Model Components Lengths | | | | Model Hughes Coefficients | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Velocity | Froude | Total Drag | Total | L=3.00' | L=3.00' | L=4.21875' | L=4.50' | CFOm (no form factor) | | | |
| (fps) | # | RTm (lbf.) | CTm | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod |
| 2.99 | 0.15 | 5 | 9.91E-03 | 830233 | 830233 | 1167515 | 1245349 | 4.36E-03 | 4.36E-03 | 4.05E-03 | 3.99E-03 |
| 3.27 | 0.17 | 5 | 8.29E-03 | 907980 | 907980 | 1276847 | 1361970 | 4.28E-03 | 4.28E-03 | 3.97E-03 | 3.92E-03 |
| 3.58 | 0.18 | 6 | 8.30E-03 | 994058 | 994058 | 1397894 | 1491087 | 4.19E-03 | 4.19E-03 | 3.90E-03 | 3.84E-03 |
| 3.88 | 0.20 | 7 | 8.24E-03 | 1077359 | 1077359 | 1515036 | 1616038 | 4.12E-03 | 4.12E-03 | 3.83E-03 | 3.78E-03 |
| 4.17 | 0.21 | 15 | 1.53E-02 | 1157883 | 1157883 | 1628273 | 1736825 | 4.06E-03 | 4.06E-03 | 3.77E-03 | 3.72E-03 |
| 4.47 | 0.23 | 24 | 2.13E-02 | 1241184 | 1241184 | 1745415 | 1861776 | 4.00E-03 | 4.00E-03 | 3.72E-03 | 3.67E-03 |
| 4.78 | 0.25 | 20 | 1.55E-02 | 1327262 | 1327262 | 1866462 | 1990892 | 3.94E-03 | 3.94E-03 | 3.67E-03 | 3.62E-03 |
| 5.08 | 0.26 | 25 | 1.72E-02 | 1410563 | 1410563 | 1983604 | 2115844 | 3.89E-03 | 3.89E-03 | 3.62E-03 | 3.58E-03 |
| 5.22 | 0.27 | 34 | 2.21E-02 | 1449436 | 1449436 | 2038270 | 2174154 | 3.87E-03 | 3.87E-03 | 3.60E-03 | 3.56E-03 |
| 5.37 | 0.28 | 46 | 2.83E-02 | 1491087 | 1491087 | 2096841 | 2236630 | 3.84E-03 | 3.84E-03 | 3.58E-03 | 3.54E-03 |
| 5.52 | 0.28 | 60 | 3.49E-02 | 1532737 | 1532737 | 2155412 | 2299106 | 3.82E-03 | 3.82E-03 | 3.56E-03 | 3.52E-03 |
| 5.67 | 0.29 | 73 | 4.02E-02 | 1574388 | 1574388 | 2213983 | 2361582 | 3.80E-03 | 3.80E-03 | 3.54E-03 | 3.50E-03 |
| 5.82 | 0.30 | 83 | 4.34E-02 | 1616038 | 1616038 | 2272554 | 2424057 | 3.78E-03 | 3.78E-03 | 3.53E-03 | 3.48E-03 |
| 5.97 | 0.31 | 90 | 4.47E-02 | 1657689 | 1657689 | 2331125 | 2486533 | 3.76E-03 | 3.76E-03 | 3.51E-03 | 3.46E-03 |
| 6.11 | 0.32 | 94 | 4.46E-02 | 1696562 | 1696562 | 2385791 | 2544844 | 3.74E-03 | 3.74E-03 | 3.49E-03 | 3.45E-03 |
| 6.26 | 0.32 | 95 | 4.30E-02 | 1738213 | 1738213 | 2444362 | 2607319 | 3.72E-03 | 3.72E-03 | 3.47E-03 | 3.43E-03 |
| 6.57 | 0.34 | 91 | 3.74E-02 | 1824291 | 1824291 | 2565409 | 2736436 | 3.69E-03 | 3.69E-03 | 3.44E-03 | 3.40E-03 |
| 6.87 | 0.35 | 83 | 3.12E-02 | 1907591 | 1907591 | 2682551 | 2861387 | 3.65E-03 | 3.65E-03 | 3.41E-03 | 3.37E-03 |
| 7.16 | 0.37 | 75 | 2.59E-02 | 1988116 | 1988116 | 2795788 | 2982174 | 3.62E-03 | 3.62E-03 | 3.38E-03 | 3.34E-03 |
| 7.46 | 0.38 | 67 | 2.13E-02 | 2071417 | 2071417 | 2912930 | 3107125 | 3.59E-03 | 3.59E-03 | 3.36E-03 | 3.31E-03 |
| 7.76 | 0.40 | 62 | 1.82E-02 | 2154718 | 2154718 | 3030072 | 3232076 | 3.56E-03 | 3.56E-03 | 3.33E-03 | 3.29E-03 |
| 8.05 | 0.42 | 58 | 1.59E-02 | 2235242 | 2235242 | 3143309 | 3352863 | 3.54E-03 | 3.54E-03 | 3.31E-03 | 3.27E-03 |
| 8.35 | 0.43 | 56 | 1.42E-02 | 2318543 | 2318543 | 3260451 | 3477814 | 3.51E-03 | 3.51E-03 | 3.28E-03 | 3.24E-03 |
| 8.95 | 0.46 | 55 | 1.22E-02 | 2485145 | 2485145 | 3494735 | 3727717 | 3.46E-03 | 3.46E-03 | 3.24E-03 | 3.20E-03 |
| 9.55 | 0.49 | 56 | 1.09E-02 | 2651747 | 2651747 | 3729019 | 3977620 | 3.42E-03 | 3.42E-03 | 3.20E-03 | 3.16E-03 |
| 10.14 | 0.52 | 58 | 1.00E-02 | 2815572 | 2815572 | 3959398 | 4223358 | 3.38E-03 | 3.38E-03 | 3.16E-03 | 3.12E-03 |
| 10.73 | 0.55 | 60 | 9.23E-03 | 2979397 | 2979397 | 4189777 | 4469095 | 3.34E-03 | 3.34E-03 | 3.13E-03 | 3.09E-03 |
| 11.34 | 0.58 | 63 | 8.68E-03 | 3148775 | 3148775 | 4427966 | 4723163 | 3.31E-03 | 3.31E-03 | 3.10E-03 | 3.06E-03 |
| 11.93 | 0.62 | 67 | 8.34E-03 | 3312601 | 3312601 | 4658345 | 4968901 | 3.27E-03 | 3.27E-03 | 3.07E-03 | 3.03E-03 |
| 12.52 | 0.65 | 70 | 7.91E-03 | 3476426 | 3476426 | 4888724 | 5214639 | 3.24E-03 | 3.24E-03 | 3.04E-03 | 3.00E-03 |
| 13.13 | 0.68 | 75 | 7.71E-03 | 3645804 | 3645804 | 5126912 | 5468707 | 3.21E-03 | 3.21E-03 | 3.01E-03 | 2.98E-03 |
| 14.33 | 0.74 | 84 | 7.25E-03 | 3979008 | 3979008 | 5595480 | 5968512 | 3.16E-03 | 3.16E-03 | 2.97E-03 | 2.93E-03 |
| 15.51 | 0.80 | 93 | 6.85E-03 | 4306659 | 4306659 | 6056239 | 6459988 | 3.11E-03 | 3.11E-03 | 2.92E-03 | 2.89E-03 |
| 16.71 | 0.86 | 103 | 6.54E-03 | 4639862 | 4639862 | 6524806 | 6959793 | 3.07E-03 | 3.07E-03 | 2.88E-03 | 2.85E-03 |
| 17.91 | 0.92 | 113 | 6.24E-03 | 4973066 | 4973066 | 6993374 | 7459599 | 3.03E-03 | 3.03E-03 | 2.85E-03 | 2.81E-03 |
| 19.09 | 0.98 | 123 | 5.98E-03 | 5300716 | 5300716 | 7454132 | 7951075 | 2.99E-03 | 2.99E-03 | 2.81E-03 | 2.78E-03 |
| 20.29 | 1.05 | 135 | 5.81E-03 | 5633920 | 5633920 | 7922700 | 8450880 | 2.96E-03 | 2.96E-03 | 2.78E-03 | 2.75E-03 |
| 21.49 | 1.11 | 147 | 5.64E-03 | 5967124 | 5967124 | 8391268 | 8950686 | 2.93E-03 | 2.93E-03 | 2.76E-03 | 2.72E-03 |
| 22.68 | 1.17 | 161 | 5.55E-03 | 6297551 | 6297551 | 8855931 | 9446326 | 2.90E-03 | 2.90E-03 | 2.73E-03 | 2.70E-03 |
| 23.87 | 1.23 | 174 | 5.41E-03 | 6627978 | 6627978 | 9320594 | 9941967 | 2.87E-03 | 2.87E-03 | 2.71E-03 | 2.67E-03 |

**Table 13**. Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Frictional Resistance of Model Components RFOm (lbf.) Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Summed Σ RFOm (lbf.) | Equivalent Frictional CFOm | Model Equivalent Reynolds # | Reynolds Scaled Resistance (Frictional + Form) (r * CFOm) | R(Rn)m (lbf.) | Model Form Cform.m | Model Form Drag (lbf.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.48 | 0.48 | 0.57 | 0.58 | 2.10 | 4.17E-03 | 1019383 | 8.13E-03 | 4.10E+00 | 3.96E-03 | 2.00 |
| 0.56 | 0.56 | 0.66 | 0.68 | 2.47 | 4.09E-03 | 1114906 | 7.97E-03 | 4.81E+00 | 3.89E-03 | 2.34 |
| 0.66 | 0.66 | 0.78 | 0.80 | 2.90 | 4.01E-03 | 1220668 | 7.82E-03 | 5.66E+00 | 3.81E-03 | 2.76 |
| 0.76 | 0.76 | 0.90 | 0.92 | 3.35 | 3.94E-03 | 1323023 | 7.69E-03 | 6.53E+00 | 3.75E-03 | 3.18 |
| 0.87 | 0.86 | 1.03 | 1.05 | 3.81 | 3.88E-03 | 1421969 | 7.57E-03 | 7.43E+00 | 3.69E-03 | 3.62 |
| 0.98 | 0.98 | 1.16 | 1.19 | 4.31 | 3.83E-03 | 1524331 | 7.46E-03 | 8.41E+00 | 3.64E-03 | 4.10 |
| 1.11 | 1.10 | 1.31 | 1.34 | 4.87 | 3.77E-03 | 1630107 | 7.36E-03 | 9.49E+00 | 3.58E-03 | 4.62 |
| 1.24 | 1.23 | 1.46 | 1.50 | 5.43 | 3.73E-03 | 1732475 | 7.27E-03 | 1.06E+01 | 3.54E-03 | 5.16 |
| 1.30 | 1.29 | 1.54 | 1.57 | 5.70 | 3.71E-03 | 1780248 | 7.23E-03 | 1.11E+01 | 3.52E-03 | 5.41 |
| 1.37 | 1.36 | 1.62 | 1.65 | 6.00 | 3.68E-03 | 1831433 | 7.18E-03 | 1.17E+01 | 3.50E 03 | 5.70 |
| 1.44 | 1.43 | 1.70 | 1.74 | 6.30 | 3.66E-03 | 1882619 | 7.14E-03 | 1.23E+01 | 3.48E 03 | 5.98 |
| 1.51 | 1.50 | 1.78 | 1.82 | 6.61 | 3.64E-03 | 1933806 | 7.10E-03 | 1.29E+01 | 3.46E-03 | 6.28 |
| 1.58 | 1.57 | 1.87 | 1.91 | 6.93 | 3.62E-03 | 1984994 | 7.07E-03 | 1.35E+01 | 3.44E-03 | 6.58 |
| 1.65 | 1.64 | 1.96 | 2.00 | 7.25 | 3.60E-03 | 2036181 | 7.03E-03 | 1.41E+01 | 3.42E-03 | 6.89 |
| 1.72 | 1.71 | 2.04 | 2.09 | 7.56 | 3.59E-03 | 2083957 | 7.00E-03 | 1.47E+01 | 3.41E-03 | 7.18 |
| 1.80 | 1.79 | 2.13 | 2.18 | 7.90 | 3.57E-03 | 2135146 | 6.96E-03 | 1.54E+01 | 3.39E-03 | 7.50 |
| 1.96 | 1.95 | 2.32 | 2.38 | 8.61 | 3.54E-03 | 2240939 | 6.89E-03 | 1.68E+01 | 3.36E-03 | 8.18 |
| 2.13 | 2.11 | 2.52 | 2.58 | 9.33 | 3.50E-03 | 2343320 | 6.83E-03 | 1.82E+01 | 3.33E-03 | 8.87 |
| 2.29 | 2.27 | 2.71 | 2.78 | 10.06 | 3.48E-03 | 2442291 | 6.78E-03 | 1.96E+01 | 3.30E-03 | 9.55 |
| 2.47 | 2.45 | 2.92 | 2.99 | 10.83 | 3.45E-03 | 2544676 | 6.72E-03 | 2.11E+01 | 3.27E-03 | 10.29 |
| 2.65 | 2.63 | 3.14 | 3.21 | 11.62 | 3.42E-03 | 2647063 | 6.67E-03 | 2.27E+01 | 3.25E-03 | 11.04 |
| 2.83 | 2.81 | 3.35 | 3.43 | 12.42 | 3.40E-03 | 2746039 | 6.62E-03 | 2.42E+01 | 3.23E-03 | 11.80 |
| 3.02 | 3.00 | 3.58 | 3.67 | 13.27 | 3.37E-03 | 2848429 | 6.57E-03 | 2.59E+01 | 3.20E-03 | 12.60 |
| 3.42 | 3.40 | 4.06 | 4.16 | 15.03 | 3.33E-03 | 3053214 | 6.49E-03 | 2.93E+01 | 3.16E-03 | 14.28 |
| 3.85 | 3.82 | 4.57 | 4.67 | 16.90 | 3.28E-03 | 3258004 | 6.40E-03 | 3.30E+01 | 3.12E-03 | 16.06 |
| 4.28 | 4.25 | 5.09 | 5.21 | 18.84 | 3.25E-03 | 3459386 | 6.33E-03 | 3.67E+01 | 3.08E-03 | 17.90 |
| 4.74 | 4.71 | 5.64 | 5.77 | 20.87 | 3.21E-03 | 3660773 | 6.26E-03 | 4.07E+01 | 3.05E-03 | 19.82 |
| 5.24 | 5.21 | 6.23 | 6.38 | 23.06 | 3.18E-03 | 3868991 | 6.20E 03 | 4.50E+01 | 3.02E 03 | 21.91 |
| 5.75 | 5.71 | 6.83 | 6.99 | 25.28 | 3.15E-03 | 4070386 | 6.14E-03 | 4.93E+01 | 2.99E-03 | 24.01 |
| 6.27 | 6.23 | 7.46 | 7.64 | 27.59 | 3.12E-03 | 4271785 | 6.08E-03 | 5.38E+01 | 2.96E-03 | 26.21 |
| 6.83 | 6.79 | 8.13 | 8.32 | 30.07 | 3.09E-03 | 4480015 | 6.03E-03 | 5.86E+01 | 2.94E-03 | 28.56 |
| 8.00 | 7.95 | 9.53 | 9.76 | 35.23 | 3.04E-03 | 4889658 | 5.93E-03 | 6.87E+01 | 2.89E-03 | 33.47 |
| 9.24 | 9.17 | 11.00 | 11.27 | 40.67 | 3.00E-03 | 5292487 | 5.84E-03 | 7.93E+01 | 2.85E-03 | 38.64 |
| 10.57 | 10.50 | 12.59 | 12.90 | 46.57 | 2.95E-03 | 5702154 | 5.76E-03 | 9.08E+01 | 2.81E-03 | 44.24 |
| 11.99 | 11.91 | 14.29 | 14.64 | 52.82 | 2.92E-03 | 6111833 | 5.69E-03 | 1.03E+02 | 2.77E-03 | 50.18 |
| 13.46 | 13.37 | 16.05 | 16.44 | 59.31 | 2.88E-03 | 6514693 | 5.62E-03 | 1.16E+02 | 2.74E-03 | 56.35 |
| 15.03 | 14.93 | 17.93 | 18.37 | 66.27 | 2.85E-03 | 6924390 | 5.56E-03 | 1.29E+02 | 2.71E-03 | 62.96 |
| 16.69 | 16.57 | 19.91 | 20.40 | 73.57 | 2.82E-03 | 7334096 | 5.50E-03 | 1.43E+02 | 2.68E-03 | 69.89 |
| 18.41 | 18.28 | 21.97 | 22.51 | 81.16 | 2.80E-03 | 7740395 | 5.45E-03 | 1.58E+02 | 2.66E-03 | 77.10 |
| 20.20 | 20.06 | 24.11 | 24.71 | 89.08 | 2.77E-03 | 8146702 | 5.40E-03 | 1.74E+02 | 2.63E-03 | 84.63 |

**Table 13.** Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Model Wave Making CWMm | Model Wave Making RWMm (lbf.) | Model Residual CRm | Model Residual RRm (lbf.) | Ship Velocity (fps) | Ship Velocity (kts.) | Ship Froude # | Reynolds # 's for Ship Components Lengths L=24.00' Fwd Strut | L=24.00' Aft Strut | L=33.75' Fwd Pod | L=36.00' Aft Pod |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.78E-03 | 0.90 | 5.74E-03 | 2.90 | 8.46 | 5.01 | 0.15 | 15868275 | 15868275 | 22314762 | 23802412 |
| 3.11E-04 | 0.19 | 4.20E-03 | 2.53 | 9.25 | 5.48 | 0.17 | 17354267 | 17354267 | 24404438 | 26031401 |
| 4.74E-04 | 0.34 | 4.28E-03 | 3.10 | 10.13 | 6.00 | 0.18 | 18999473 | 18999473 | 26718009 | 28499209 |
| 5.51E-04 | 0.47 | 4.30E-03 | 3.65 | 10.97 | 6.50 | 0.20 | 20591608 | 20591608 | 28956948 | 30887411 |
| 7.71E-03 | 7.57 | 1.14E-02 | 11.19 | 11.79 | 6.98 | 0.21 | 22130671 | 22130671 | 31121256 | 33196007 |
| 1.38E-02 | 15.59 | 1.75E-02 | 19.69 | 12.64 | 7.49 | 0.23 | 23722806 | 23722806 | 33360195 | 35584208 |
| 8.15E-03 | 10.51 | 1.17E-02 | 15.13 | 13.52 | 8.01 | 0.25 | 25368011 | 25368011 | 35673766 | 38052017 |
| 9.90E-03 | 14.42 | 1.34E-02 | 19.57 | 14.37 | 8.51 | 0.26 | 26960146 | 26960146 | 37912705 | 40440219 |
| 1.49E-02 | 22.89 | 1.84E-02 | 28.30 | 14.76 | 8.74 | 0.27 | 27703142 | 27703142 | 38957544 | 41554713 |
| 2.11E-02 | 34.31 | 2.46E-02 | 40.00 | 15.19 | 8.99 | 0.28 | 28499209 | 28499209 | 40077013 | 42748814 |
| 2.77E-02 | 47.72 | 3.12E-02 | 53.70 | 15.61 | 9.24 | 0.28 | 29295277 | 29295277 | 41196483 | 43942915 |
| 3.31E-02 | 60.11 | 3.66E-02 | 66.39 | 16.04 | 9.50 | 0.29 | 30091344 | 30091344 | 42315953 | 45137016 |
| 3.64E-02 | 69.49 | 3.98E-02 | 76.07 | 16.46 | 9.75 | 0.30 | 30887411 | 30887411 | 43435422 | 46331117 |
| 3.77E-02 | 75.86 | 4.11E-02 | 82.75 | 16.89 | 10.00 | 0.31 | 31683479 | 31683479 | 44554892 | 47525218 |
| 3.76E-02 | 79.26 | 4.10E-02 | 86.44 | 17.28 | 10.23 | 0.32 | 32426475 | 32426475 | 45599730 | 48639712 |
| 3.60E-02 | 79.60 | 3.94E-02 | 87.10 | 17.71 | 10.48 | 0.32 | 33222542 | 33222542 | 46719200 | 49833813 |
| 3.05E-02 | 74.20 | 3.38E-02 | 82.39 | 18.58 | 11.00 | 0.34 | 34867748 | 34867748 | 49032770 | 52301622 |
| 2.43E-02 | 64.80 | 2.77E-02 | 73.67 | 19.43 | 11.51 | 0.35 | 36459882 | 36459882 | 51271710 | 54689824 |
| 1.91E-02 | 55.39 | 2.24E-02 | 64.94 | 20.25 | 11.99 | 0.37 | 37998946 | 37998946 | 53436018 | 56998419 |
| 1.46E-02 | 45.89 | 1.79E-02 | 56.17 | 21.10 | 12.49 | 0.38 | 39591080 | 39591080 | 55674957 | 59386621 |
| 1.16E-02 | 39.33 | 1.48E-02 | 50.38 | 21.95 | 13.00 | 0.40 | 41183215 | 41183215 | 57913896 | 61774823 |
| 9.24E-03 | 33.78 | 1.25E-02 | 45.58 | 22.77 | 13.48 | 0.42 | 42722279 | 42722279 | 60078204 | 64083418 |
| 7.66E-03 | 30.13 | 1.09E-02 | 42.73 | 23.62 | 13.98 | 0.43 | 44314413 | 44314413 | 62317144 | 66471620 |
| 5.68E-03 | 25.68 | 8.84E-03 | 39.97 | 25.31 | 14.99 | 0.46 | 47498682 | 47498682 | 66795022 | 71248024 |
| 4.48E-03 | 23.04 | 7.60E-03 | 39.10 | 27.01 | 15.99 | 0.49 | 50682952 | 50682952 | 71272901 | 76024427 |
| 3.67E-03 | 21.27 | 6.75E-03 | 39.16 | 28.68 | 16.98 | 0.52 | 53814150 | 53814150 | 75676148 | 80721224 |
| 2.97E-03 | 19.31 | 6.02E-03 | 39.13 | 30.35 | 17.97 | 0.55 | 56945348 | 56945348 | 80079395 | 85418022 |
| 2.48E-03 | 18.03 | 5.50E-03 | 39.94 | 32.07 | 18.99 | 0.58 | 60182688 | 60182688 | 84631905 | 90274032 |
| 2.20E-03 | 17.71 | 5.19E-03 | 41.72 | 33.74 | 19.98 | 0.62 | 63313886 | 63313886 | 89035152 | 94970829 |
| 1.83E-03 | 16.21 | 4.79E-03 | 42.41 | 35.41 | 20.97 | 0.65 | 66445084 | 66445084 | 93438400 | 99667626 |
| 1.68E-03 | 16.37 | 4.62E-03 | 44.93 | 37.14 | 21.99 | 0.68 | 69682425 | 69682425 | 97990909 | 104523637 |
| 1.32E-03 | 15.29 | 4.21E-03 | 48.77 | 40.53 | 24.00 | 0.74 | 76050963 | 76050963 | 106946667 | 114076444 |
| 1.01E-03 | 13.69 | 3.85E-03 | 52.33 | 43.87 | 25.98 | 0.80 | 82313359 | 82313359 | 115753161 | 123470039 |
| 7.74E-04 | 12.20 | 3.58E-03 | 56.43 | 47.26 | 27.98 | 0.86 | 88681897 | 88681897 | 124708918 | 133022846 |
| 5.53E-04 | 10.01 | 3.32E-03 | 60.18 | 50.66 | 29.99 | 0.92 | 95050436 | 95050436 | 133664675 | 142575654 |
| 3.57E-04 | 7.34 | 3.10E-03 | 63.69 | 53.99 | 31.97 | 0.98 | 101312832 | 101312832 | 142471170 | 151969248 |
| 2.49E-04 | 5.78 | 2.96E-03 | 68.73 | 57.39 | 33.98 | 1.05 | 107681370 | 107681370 | 151426927 | 161522056 |
| 1.36E-04 | 3.53 | 2.82E-03 | 73.43 | 60.78 | 35.99 | 1.11 | 114049909 | 114049909 | 160382684 | 171074863 |
| 9.44E-05 | 2.74 | 2.75E-03 | 79.84 | 64.15 | 37.98 | 1.17 | 120365376 | 120365376 | 169263810 | 180548064 |
| 8.98E-06 | 0.29 | 2.64E-03 | 84.92 | 67.51 | 39.98 | 1.23 | 126680843 | 126680843 | 178144936 | 190021265 |

**Table 13**. Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Ship Hughes Coefficients | | | | Frictional Resistance of Ship Components | | | | Summed | Equivalent | Ship |
|---|---|---|---|---|---|---|---|---|---|---|
| CFOs (no form factor) | | | | RFOs (lbf.) | | | | Σ RFOs | Frictional | Equivalent |
| Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | (lbf.) | CFOs | Reynolds # |
| 2.47E-03 | 2.47E-03 | 2.33E-03 | 2.31E-03 | 143 | 142 | 172 | 176 | 633 | 2.39E-03 | 19510913 |
| 2.43E-03 | 2.43E-03 | 2.30E-03 | 2.28E-03 | 169 | 168 | 202 | 208 | 746 | 2.35E-03 | 21338704 |
| 2.40E-03 | 2.40E-03 | 2.27E-03 | 2.24E-03 | 199 | 198 | 239 | 245 | 881 | 2.32E-03 | 23362384 |
| 2.36E-03 | 2.36E-03 | 2.24E-03 | 2.21E-03 | 231 | 229 | 277 | 284 | 1022 | 2.29E-03 | 25320833 |
| 2.34E-03 | 2.34E-03 | 2.21E-03 | 2.19E-03 | 264 | 262 | 317 | 325 | 1167 | 2.26E-03 | 27214042 |
| 2.31E-03 | 2.31E-03 | 2.19E-03 | 2.17E-03 | 300 | 297 | 360 | 369 | 1326 | 2.23E-03 | 29172574 |
| 2.29E-03 | 2.29E-03 | 2.16E-03 | 2.14E-03 | 339 | 336 | 407 | 418 | 1500 | 2.21E-03 | 31196429 |
| 2.26E-03 | 2.26E-03 | 2.14E-03 | 2.12E-03 | 379 | 376 | 455 | 467 | 1678 | 2.19E-03 | 33155034 |
| 2.25E-03 | 2.25E-03 | 2.13E-03 | 2.11E-03 | 398 | 396 | 479 | 491 | 1764 | 2.18E-03 | 34069060 |
| 2.24E-03 | 2.24E-03 | 2.13E-03 | 2.10E-03 | 420 | 417 | 504 | 518 | 1859 | 2.17E-03 | 35048382 |
| 2.23E-03 | 2.23E-03 | 2.12E-03 | 2.09E-03 | 441 | 438 | 531 | 545 | 1955 | 2.16E-03 | 36027711 |
| 2.22E-03 | 2.22E-03 | 2.11E-03 | 2.09E-03 | 464 | 461 | 558 | 572 | 2054 | 2.15E-03 | 37007048 |
| 2.21E-03 | 2.21E-03 | 2.10E-03 | 2.08E-03 | 487 | 483 | 585 | 601 | 2156 | 2.14E-03 | 37986392 |
| 2.21E-03 | 2.21E-03 | 2.09E-03 | 2.07E-03 | 510 | 506 | 613 | 629 | 2259 | 2.13E-03 | 38965742 |
| 2.20E-03 | 2.20E-03 | 2.08E-03 | 2.06E-03 | 532 | 529 | 640 | 657 | 2358 | 2.13E-03 | 39879809 |
| 2.19E-03 | 2.19E-03 | 2.08E-03 | 2.05E-03 | 557 | 553 | 669 | 687 | 2466 | 2.12E-03 | 40859172 |
| 2.17E-03 | 2.17E-03 | 2.06E-03 | 2.04E-03 | 608 | 604 | 732 | 751 | 2696 | 2.10E-03 | 42883210 |
| 2.16E-03 | 2.16E-03 | 2.05E-03 | 2.03E-03 | 661 | 656 | 795 | 816 | 2927 | 2.09E-03 | 44841980 |
| 2.14E-03 | 2.14E-03 | 2.03E-03 | 2.01E-03 | 713 | 708 | 858 | 881 | 3159 | 2.08E-03 | 46735479 |
| 2.13E-03 | 2.13E-03 | 2.02E-03 | 2.00E-03 | 769 | 764 | 926 | 950 | 3408 | 2.06E-03 | 48694293 |
| 2.12E-03 | 2.12E-03 | 2.01E-03 | 1.99E-03 | 827 | 821 | 996 | 1022 | 3665 | 2.05E-03 | 50653128 |
| 2.10E-03 | 2.10E-03 | 2.00E-03 | 1.98E-03 | 885 | 879 | 1065 | 1094 | 3922 | 2.04E-03 | 52546687 |
| 2.09E-03 | 2.09E-03 | 1.99E-03 | 1.97E-03 | 947 | 940 | 1140 | 1170 | 4197 | 2.03E-03 | 54505560 |
| 2.07E-03 | 2.07E-03 | 1.97E-03 | 1.95E-03 | 1076 | 1069 | 1296 | 1330 | 4771 | 2.01E-03 | 58423360 |
| 2.05E-03 | 2.05E-03 | 1.95E-03 | 1.93E-03 | 1213 | 1205 | 1461 | 1500 | 5379 | 1.99E-03 | 62341227 |
| 2.03E-03 | 2.03E-03 | 1.93E-03 | 1.91E-03 | 1355 | 1346 | 1633 | 1676 | 6010 | 1.97E-03 | 66193858 |
| 2.01E-03 | 2.01E-03 | 1.91E-03 | 1.90E-03 | 1504 | 1494 | 1813 | 1862 | 6673 | 1.95E-03 | 70046545 |
| 2.00E-03 | 2.00E-03 | 1.90E-03 | 1.88E-03 | 1666 | 1655 | 2009 | 2062 | 7392 | 1.94E-03 | 74029887 |
| 1.98E-03 | 1.98E-03 | 1.88E-03 | 1.87E-03 | 1830 | 1817 | 2207 | 2266 | 8120 | 1.92E-03 | 77882679 |
| 1.97E-03 | 1.97E-03 | 1.87E-03 | 1.85E-03 | 2001 | 1987 | 2413 | 2478 | 8879 | 1.91E-03 | 81735518 |
| 1.95E-03 | 1.95E-03 | 1.86E-03 | 1.84E-03 | 2185 | 2170 | 2636 | 2706 | 9697 | 1.89E-03 | 85719008 |
| 1.93E-03 | 1.93E-03 | 1.83E-03 | 1.82E-03 | 2569 | 2551 | 3100 | 3183 | 11403 | 1.87E-03 | 93555512 |
| 1.91E-03 | 1.91E-03 | 1.81E-03 | 1.80E-03 | 2974 | 2954 | 3590 | 3687 | 13206 | 1.85E-03 | 101261561 |
| 1.88E-03 | 1.88E-03 | 1.79E-03 | 1.78E-03 | 3415 | 3391 | 4123 | 4234 | 15163 | 1.83E-03 | 109098365 |
| 1.87E-03 | 1.87E-03 | 1.78E-03 | 1.76E-03 | 3883 | 3856 | 4690 | 4816 | 17246 | 1.81E-03 | 116935301 |
| 1.85E-03 | 1.85E-03 | 1.76E-03 | 1.74E-03 | 4371 | 4341 | 5280 | 5423 | 19415 | 1.79E-03 | 124641742 |
| 1.83E-03 | 1.83E-03 | 1.74E-03 | 1.73E-03 | 4894 | 4861 | 5914 | 6074 | 21742 | 1.78E-03 | 132478913 |
| 1.82E-03 | 1.82E-03 | 1.73E-03 | 1.72E-03 | 5445 | 5407 | 6580 | 6759 | 24191 | 1.76E-03 | 140316191 |
| 1.80E-03 | 1.80E-03 | 1.72E-03 | 1.70E-03 | 6018 | 5976 | 7274 | 7471 | 26739 | 1.75E-03 | 148088257 |
| 1.79E-03 | 1.79E-03 | 1.71E-03 | 1.69E-03 | 6617 | 6572 | 8000 | 8217 | 29406 | 1.74E-03 | 155860415 |

**Table 13.** Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Reynolds Scaled Resistance (Frictional + Form) | | Ship Form | Ship From Drag | Ship Wave Making | Ship Wave Making | Ship Residual | Ship Residual | Ship Allowance | Ship Allowance |
|---|---|---|---|---|---|---|---|---|---|
| (r*CFOs) | R(Rn)s (lbf.) | Cform.s | (lbf.) | CWMs | RWMs (lbf.) | CRs | RRs (lbf.) | CA | RAs (lbf.) |
| 4.65E-03 | 1235 | 2.27E-03 | 602 | 1.78E-03 | 472 | 4.04E-03 | 1074 | 0.0005 | 133 |
| 4.58E-03 | 1455 | 2.23E-03 | 709 | 3.11E-04 | 99 | 2.54E-03 | 808 | 0.0005 | 159 |
| 4.52E-03 | 1719 | 2.20E-03 | 837 | 4.74E-04 | 181 | 2.67E-03 | 1018 | 0.0005 | 190 |
| 4.46E-03 | 1993 | 2.17E-03 | 971 | 5.51E-04 | 246 | 2.72E-03 | 1217 | 0.0005 | 224 |
| 4.41E-03 | 2275 | 2.15E-03 | 1108 | 7.71E-03 | 3983 | 9.86E-03 | 5092 | 0.0005 | 258 |
| 4.36E-03 | 2585 | 2.12E-03 | 1260 | 1.38E-02 | 8202 | 1.59E-02 | 9461 | 0.0005 | 297 |
| 4.31E-03 | 2925 | 2.10E-03 | 1425 | 8.15E-03 | 5532 | 1.03E-02 | 6957 | 0.0005 | 339 |
| 4.27E-03 | 3272 | 2.08E-03 | 1594 | 9.90E-03 | 7587 | 1.20E-02 | 9181 | 0.0005 | 383 |
| 4.25E-03 | 3440 | 2.07E-03 | 1676 | 1.49E-02 | 12045 | 1.70E-02 | 13721 | 0.0005 | 405 |
| 4.23E-03 | 3624 | 2.06E-03 | 1766 | 2.11E-02 | 18054 | 2.31E-02 | 19820 | 0.0005 | 428 |
| 4.21E-03 | 3813 | 2.05E-03 | 1858 | 2.77E-02 | 25110 | 2.98E-02 | 26967 | 0.0005 | 452 |
| 4.20E-03 | 4006 | 2.04E-03 | 1952 | 3.31E-02 | 31632 | 3.52E-02 | 33584 | 0.0005 | 477 |
| 4.18E-03 | 4204 | 2.04E-03 | 2048 | 3.64E-02 | 36568 | 3.84E-02 | 38616 | 0.0005 | 503 |
| 4.16E-03 | 4406 | 2.03E-03 | 2146 | 3.77E-02 | 39919 | 3.97E-02 | 42066 | 0.0005 | 529 |
| 4.15E-03 | 4598 | 2.02E-03 | 2240 | 3.76E-02 | 41708 | 3.96E-02 | 43948 | 0.0005 | 554 |
| 4.13E-03 | 4808 | 2.01E-03 | 2342 | 3.60E-02 | 41888 | 3.80E-02 | 44231 | 0.0005 | 582 |
| 4.10E-03 | 5257 | 2.00E-03 | 2561 | 3.05E-02 | 39048 | 3.25E-02 | 41609 | 0.0005 | 641 |
| 4.07E-03 | 5708 | 1.98E-03 | 2781 | 2.43E-02 | 34099 | 2.63E-02 | 36879 | 0.0005 | 701 |
| 4.05E-03 | 6161 | 1.97E-03 | 3001 | 1.91E-02 | 29149 | 2.11E-02 | 32150 | 0.0005 | 761 |
| 4.02E-03 | 6646 | 1.96E-03 | 3238 | 1.46E-02 | 24147 | 1.66E-02 | 27385 | 0.0005 | 826 |
| 4.00E-03 | 7148 | 1.95E-03 | 3482 | 1.16E-02 | 20698 | 1.35E-02 | 24180 | 0.0005 | 894 |
| 3.97E-03 | 7649 | 1.94E-03 | 3726 | 9.24E-03 | 17778 | 1.12E-02 | 21504 | 0.0005 | 962 |
| 3.95E-03 | 8184 | 1.93E-03 | 3987 | 7.66E-03 | 15856 | 9.58E-03 | 19843 | 0.0005 | 1035 |
| 3.91E-03 | 9303 | 1.91E-03 | 4532 | 5.68E-03 | 13514 | 7.59E-03 | 18047 | 0.0005 | 1189 |
| 3.87E-03 | 10489 | 1.89E-03 | 5110 | 4.48E-03 | 12123 | 6.36E-03 | 17233 | 0.0005 | 1354 |
| 3.84E-03 | 11719 | 1.87E-03 | 5709 | 3.67E-03 | 11191 | 5.53E-03 | 16901 | 0.0005 | 1527 |
| 3.81E-03 | 13012 | 1.85E-03 | 6339 | 2.97E-03 | 10163 | 4.83E-03 | 16502 | 0.0005 | 1710 |
| 3.77E-03 | 14414 | 1.84E-03 | 7022 | 2.48E-03 | 9490 | 4.32E-03 | 16512 | 0.0005 | 1910 |
| 3.75E-03 | 15834 | 1.82E-03 | 7714 | 2.20E-03 | 9320 | 4.03E-03 | 17033 | 0.0005 | 2113 |
| 3.72E-03 | 17314 | 1.81E-03 | 8435 | 1.83E-03 | 8529 | 3.64E-03 | 16964 | 0.0005 | 2328 |
| 3.69E-03 | 18909 | 1.80E-03 | 9212 | 1.68E-03 | 8613 | 3.48E-03 | 17825 | 0.0005 | 2560 |
| 3.65E-03 | 22237 | 1.78E-03 | 10833 | 1.32E-03 | 8048 | 3.10E-03 | 18882 | 0.0005 | 3049 |
| 3.60E-03 | 25751 | 1.76E-03 | 12545 | 1.01E-03 | 7203 | 2.76E-03 | 19748 | 0.0005 | 3572 |
| 3.57E-03 | 29568 | 1.74E-03 | 14405 | 7.74E-04 | 6419 | 2.51E-03 | 20824 | 0.0005 | 4146 |
| 3.53E-03 | 33629 | 1.72E-03 | 16384 | 5.53E-04 | 5265 | 2.27E-03 | 21649 | 0.0005 | 4763 |
| 3.50E-03 | 37858 | 1.70E-03 | 18444 | 3.57E-04 | 3862 | 2.06E-03 | 22306 | 0.0005 | 5411 |
| 3.47E-03 | 42397 | 1.69E-03 | 20655 | 2.49E-04 | 3040 | 1.94E-03 | 23694 | 0.0005 | 6113 |
| 3.44E-03 | 47172 | 1.68E-03 | 22981 | 1.36E-04 | 1859 | 1.81E-03 | 24840 | 0.0005 | 6858 |
| 3.41E-03 | 52141 | 1.66E-03 | 25402 | 9.44E-05 | 1442 | 1.76E-03 | 26844 | 0.0005 | 7638 |
| 3.39E-03 | 57341 | 1.65E-03 | 27935 | 8.98E-06 | 152 | 1.66E-03 | 28087 | 0.0005 | 8461 |

**Table 13**. Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Ship Total CTs | Ship Total Resistance RTs (lbf.) | Ship EHP (hp) | Ship SHP (hp) | Model Reynolds Scaled C | Model Reynolds Scaled (lbf.) | Model Froude Scaled C | Model Froude Scaled (lbf.) | Ship Reynolds Scaled C | Ship Reynolds Scaled (lbf.) | Ship Froude Scaled C | Ship Froude Scaled (lbf.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.93E-03 | 1840 | 28 | 39 | 8.13E-03 | 4 | 1.78E-03 | 0.90 | 4.65E-03 | 1235 | 1.78E-03 | 472 |
| 5.39E-03 | 1713 | 29 | 39 | 7.97E-03 | 5 | 3.11E-04 | 0.19 | 4.58E-03 | 1455 | 3.11E-04 | 99 |
| 5.49E-03 | 2090 | 38 | 53 | 7.82E-03 | 6 | 4.74E-04 | 0.34 | 4.52E-03 | 1719 | 4.74E-04 | 181 |
| 5.51E-03 | 2463 | 49 | 67 | 7.69E-03 | 7 | 5.51E-04 | 0.47 | 4.46E-03 | 1993 | 5.51E-04 | 246 |
| 1.26E-02 | 6517 | 140 | 191 | 7.57E-03 | 7 | 7.71E-03 | 7.57 | 4.41E-03 | 2275 | 7.71E-03 | 3983 |
| 1.87E-02 | 11084 | 255 | 349 | 7.46E-03 | 8 | 1.38E-02 | 15.59 | 4.36E-03 | 2585 | 1.38E-02 | 8202 |
| 1.30E-02 | 8796 | 216 | 296 | 7.36E-03 | 9 | 8.15E-03 | 10.51 | 4.31E-03 | 2925 | 8.15E-03 | 5532 |
| 1.47E-02 | 11242 | 294 | 402 | 7.27E-03 | 11 | 9.90E-03 | 14.42 | 4.27E-03 | 3272 | 9.90E-03 | 7587 |
| 1.96E-02 | 15889 | 427 | 584 | 7.23E-03 | 11 | 1.49E-02 | 22.89 | 4.25E-03 | 3440 | 1.49E-02 | 12045 |
| 2.58E-02 | 22107 | 610 | 836 | 7.18E-03 | 12 | 2.11E-02 | 34.31 | 4.23E-03 | 3624 | 2.11E-02 | 18054 |
| 3.25E-02 | 29375 | 834 | 1142 | 7.14E-03 | 12 | 2.77E-02 | 47.72 | 4.21E-03 | 3813 | 2.77E-02 | 25110 |
| 3.78E-02 | 36115 | 1053 | 1443 | 7.10E-03 | 13 | 3.31E-02 | 60.11 | 4.20E-03 | 4006 | 3.31E-02 | 31632 |
| 4.10E-02 | 41275 | 1235 | 1692 | 7.07E-03 | 14 | 3.64E-02 | 69.49 | 4.18E-03 | 4204 | 3.64E-02 | 36568 |
| 4.24E-02 | 44854 | 1377 | 1886 | 7.03E-03 | 14 | 3.77E-02 | 75.86 | 4.16E-03 | 4406 | 3.77E-02 | 39919 |
| 4.23E-02 | 46860 | 1472 | 2017 | 7.00E-03 | 15 | 3.76E-02 | 79.26 | 4.15E-03 | 4598 | 3.76E-02 | 41708 |
| 4.06E-02 | 47279 | 1522 | 2085 | 6.96E-03 | 15 | 3.60E-02 | 79.60 | 4.13E-03 | 4808 | 3.60E-02 | 41888 |
| 3.51E-02 | 44945 | 1519 | 2080 | 6.89E-03 | 17 | 3.05E-02 | 74.20 | 4.10E-03 | 5257 | 3.05E-02 | 39048 |
| 2.89E-02 | 40507 | 1431 | 1960 | 6.83E-03 | 18 | 2.43E-02 | 64.80 | 4.07E-03 | 5708 | 2.43E-02 | 34099 |
| 2.37E-02 | 36071 | 1328 | 1819 | 6.78E-03 | 20 | 1.91E-02 | 55.39 | 4.05E-03 | 6161 | 1.91E-02 | 29149 |
| 1.91E-02 | 31619 | 1213 | 1662 | 6.72E-03 | 21 | 1.46E-02 | 45.89 | 4.02E-03 | 6646 | 1.46E-02 | 24147 |
| 1.61E-02 | 28740 | 1147 | 1571 | 6.67E-03 | 23 | 1.16E-02 | 39.33 | 4.00E-03 | 7148 | 1.16E-02 | 20698 |
| 1.37E-02 | 26389 | 1092 | 1496 | 6.62E-03 | 24 | 9.24E-03 | 33.78 | 3.97E-03 | 7649 | 9.24E-03 | 17778 |
| 1.21E-02 | 25075 | 1077 | 1475 | 6.57E-03 | 26 | 7.66E-03 | 30.13 | 3.95E-03 | 8184 | 7.66E-03 | 15856 |
| 1.01E-02 | 24007 | 1105 | 1514 | 6.49E-03 | 29 | 5.68E-03 | 25.68 | 3.91E-03 | 9303 | 5.68E-03 | 13514 |
| 8.85E-03 | 23967 | 1177 | 1612 | 6.40E-03 | 33 | 4.48E-03 | 23.04 | 3.87E-03 | 10489 | 4.48E-03 | 12123 |
| 8.00E-03 | 24437 | 1274 | 1746 | 6.33E-03 | 37 | 3.67E-03 | 21.27 | 3.84E-03 | 11719 | 3.67E-03 | 11191 |
| 7.28E-03 | 24885 | 1373 | 1881 | 6.26E-03 | 41 | 2.97E-03 | 19.31 | 3.81E-03 | 13012 | 2.97E-03 | 10163 |
| 6.76E-03 | 25813 | 1505 | 2062 | 6.20E-03 | 45 | 2.48E-03 | 18.03 | 3.77E-03 | 14414 | 2.48E-03 | 9490 |
| 6.45E-03 | 27267 | 1673 | 2292 | 6.14E-03 | 49 | 2.20E-03 | 17.71 | 3.75E-03 | 15834 | 2.20E-03 | 9320 |
| 6.05E-03 | 28171 | 1814 | 2485 | 6.08E-03 | 54 | 1.83E-03 | 16.21 | 3.72E-03 | 17314 | 1.83E-03 | 8529 |
| 5.88E-03 | 30082 | 2031 | 2782 | 6.03E-03 | 59 | 1.68E-03 | 16.37 | 3.69E-03 | 18909 | 1.68E-03 | 8613 |
| 5.47E-03 | 33334 | 2457 | 3365 | 5.93E-03 | 69 | 1.32E-03 | 15.29 | 3.65E-03 | 22237 | 1.32E-03 | 8048 |
| 5.11E-03 | 36526 | 2913 | 3991 | 5.84E-03 | 79 | 1.01E-03 | 13.69 | 3.60E-03 | 25751 | 1.01E-03 | 7203 |
| 4.84E-03 | 40133 | 3449 | 4724 | 5.76E-03 | 91 | 7.74E-04 | 12.20 | 3.57E-03 | 29568 | 7.74E-04 | 6419 |
| 4.58E-03 | 43658 | 4021 | 5508 | 5.69E-03 | 103 | 5.53E-04 | 10.01 | 3.53E-03 | 33629 | 5.53E-04 | 5265 |
| 4.35E-03 | 47132 | 4627 | 6338 | 5.62E-03 | 116 | 3.57E-04 | 7.34 | 3.50E-03 | 37858 | 3.57E-04 | 3862 |
| 4.22E-03 | 51549 | 5379 | 7368 | 5.56E-03 | 129 | 2.49E-04 | 5.78 | 3.47E-03 | 42397 | 2.49E-04 | 3040 |
| 4.07E-03 | 55889 | 6176 | 8461 | 5.50E-03 | 143 | 1.36E-04 | 3.53 | 3.44E-03 | 47172 | 1.36E-04 | 1859 |
| 4.01E-03 | 61221 | 7140 | 9781 | 5.45E-03 | 158 | 9.44E-05 | 2.74 | 3.41E-03 | 52141 | 9.44E-05 | 1442 |
| 3.90E-03 | 65954 | 8096 | 11090 | 5.40E-03 | 174 | 8.98E-06 | 0.29 | 3.39E-03 | 57341 | 8.98E-06 | 152 |

**Table 13**. Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

## D. MODIFIED HUGHES METHOD

This Table shows the spreadsheet analysis for the modified Hughes method.

| Model | Model | Model | Model | Reynolds #'s for Model Components Lengths | | | | Model Hughes Coefficients | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Velocity | Froude | Total Drag | Total | L=3.00' | L=3.00' | L=4.21875' | L=4.50' | CFOm (no form factor) | | | |
| (fps) | # | RTm (lbf.) | CTm | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod |
| 2.99 | 0.15 | 5 | 9.91E-03 | 830233 | 830233 | 1167515 | 1245349 | 4.36E-03 | 4.36E-03 | 4.05E-03 | 3.99E-03 |
| 3.27 | 0.17 | 5 | 8.29E-03 | 907980 | 907980 | 1276847 | 1361970 | 4.28E-03 | 4.28E-03 | 3.97E-03 | 3.92E-03 |
| 3.58 | 0.18 | 6 | 8.30E-03 | 994058 | 994058 | 1397894 | 1491087 | 4.19E-03 | 4.19E-03 | 3.90E-03 | 3.84E-03 |
| 3.88 | 0.20 | 7 | 8.24E-03 | 1077359 | 1077359 | 1515036 | 1616038 | 4.12E-03 | 4.12E-03 | 3.83E-03 | 3.78E-03 |
| 4.17 | 0.21 | 15 | 1.53E-02 | 1157883 | 1157883 | 1628273 | 1736825 | 4.06E-03 | 4.06E-03 | 3.77E-03 | 3.72E-03 |
| 4.47 | 0.23 | 24 | 2.13E-02 | 1241184 | 1241184 | 1745415 | 1861776 | 4.00E-03 | 4.00E-03 | 3.72E-03 | 3.67E-03 |
| 4.78 | 0.25 | 20 | 1.55E-02 | 1327262 | 1327262 | 1866462 | 1990892 | 3.94E-03 | 3.94E-03 | 3.67E-03 | 3.62E-03 |
| 5.08 | 0.26 | 25 | 1.72E-02 | 1410563 | 1410563 | 1983604 | 2115844 | 3.89E-03 | 3.89E-03 | 3.62E-03 | 3.58E-03 |
| 5.22 | 0.27 | 34 | 2.21E-02 | 1449436 | 1449436 | 2038270 | 2174154 | 3.87E-03 | 3.87E-03 | 3.60E-03 | 3.56E-03 |
| 5.37 | 0.28 | 46 | 2.83E-02 | 1491087 | 1491087 | 2096841 | 2236630 | 3.84E-03 | 3.84E-03 | 3.58E-03 | 3.54E-03 |
| 5.52 | 0.28 | 60 | 3.49E-02 | 1532737 | 1532737 | 2155412 | 2299106 | 3.82E-03 | 3.82E-03 | 3.56E-03 | 3.52E-03 |
| 5.67 | 0.29 | 73 | 4.02E-02 | 1574388 | 1574388 | 2213983 | 2361582 | 3.80E-03 | 3.80E-03 | 3.54E-03 | 3.50E-03 |
| 5.82 | 0.30 | 83 | 4.34E-02 | 1616038 | 1616038 | 2272554 | 2424057 | 3.78E-03 | 3.78E-03 | 3.53E-03 | 3.48E-03 |
| 5.97 | 0.31 | 90 | 4.47E-02 | 1657689 | 1657689 | 2331125 | 2486533 | 3.76E-03 | 3.76E-03 | 3.51E-03 | 3.46E-03 |
| 6.11 | 0.32 | 94 | 4.46E-02 | 1696562 | 1696562 | 2385791 | 2544844 | 3.74E-03 | 3.74E-03 | 3.49E-03 | 3.45E-03 |
| 6.26 | 0.32 | 95 | 4.30E-02 | 1738213 | 1738213 | 2444362 | 2607319 | 3.72E-03 | 3.72E-03 | 3.47E-03 | 3.43E-03 |
| 6.57 | 0.34 | 91 | 3.74E-02 | 1824291 | 1824291 | 2565409 | 2736436 | 3.69E-03 | 3.69E-03 | 3.44E-03 | 3.40E-03 |
| 6.87 | 0.35 | 83 | 3.12E-02 | 1907591 | 1907591 | 2682551 | 2861387 | 3.65E-03 | 3.65E-03 | 3.41E-03 | 3.37E-03 |
| 7.16 | 0.37 | 75 | 2.59E-02 | 1988116 | 1988116 | 2795788 | 2982174 | 3.62E-03 | 3.62E-03 | 3.38E-03 | 3.34E-03 |
| 7.46 | 0.38 | 67 | 2.13E-02 | 2071417 | 2071417 | 2912930 | 3107125 | 3.59E-03 | 3.59E-03 | 3.36E-03 | 3.31E-03 |
| 7.76 | 0.40 | 62 | 1.82E-02 | 2154718 | 2154718 | 3030072 | 3232076 | 3.56E-03 | 3.56E-03 | 3.33E-03 | 3.29E-03 |
| 8.05 | 0.42 | 58 | 1.59E-02 | 2235242 | 2235242 | 3143309 | 3352863 | 3.54E-03 | 3.54E-03 | 3.31E-03 | 3.27E-03 |
| 8.35 | 0.43 | 56 | 1.42E-02 | 2318543 | 2318543 | 3260451 | 3477814 | 3.51E-03 | 3.51E-03 | 3.28E-03 | 3.24E-03 |
| 8.95 | 0.46 | 55 | 1.22E-02 | 2485145 | 2485145 | 3494735 | 3727717 | 3.46E-03 | 3.46E-03 | 3.24E-03 | 3.20E-03 |
| 9.55 | 0.49 | 56 | 1.09E-02 | 2651747 | 2651747 | 3729019 | 3977620 | 3.42E-03 | 3.42E-03 | 3.20E-03 | 3.16E-03 |
| 10.14 | 0.52 | 58 | 1.00E-02 | 2815572 | 2815572 | 3959398 | 4223358 | 3.38E-03 | 3.38E-03 | 3.16E-03 | 3.12E-03 |
| 10.73 | 0.55 | 60 | 9.23E-03 | 2979397 | 2979397 | 4189777 | 4469095 | 3.34E-03 | 3.34E-03 | 3.13E-03 | 3.09E-03 |
| 11.34 | 0.58 | 63 | 8.68E-03 | 3148775 | 3148775 | 4427966 | 4723163 | 3.31E-03 | 3.31E-03 | 3.10E-03 | 3.06E-03 |
| 11.93 | 0.62 | 67 | 8.34E-03 | 3312601 | 3312601 | 4658345 | 4968901 | 3.27E-03 | 3.27E-03 | 3.07E-03 | 3.03E-03 |
| 12.52 | 0.65 | 70 | 7.91E-03 | 3476426 | 3476426 | 4888724 | 5214639 | 3.24E-03 | 3.24E-03 | 3.04E-03 | 3.00E-03 |
| 13.13 | 0.68 | 75 | 7.71E-03 | 3645804 | 3645804 | 5126912 | 5468707 | 3.21E-03 | 3.21E-03 | 3.01E-03 | 2.98E-03 |
| 14.33 | 0.74 | 84 | 7.25E-03 | 3979008 | 3979008 | 5595480 | 5968512 | 3.16E-03 | 3.16E-03 | 2.97E-03 | 2.93E-03 |
| 15.51 | 0.80 | 93 | 6.85E-03 | 4306659 | 4306659 | 6056239 | 6459988 | 3.11E-03 | 3.11E-03 | 2.92E-03 | 2.89E-03 |
| 16.71 | 0.86 | 103 | 6.54E-03 | 4639862 | 4639862 | 6524806 | 6959793 | 3.07E-03 | 3.07E-03 | 2.88E-03 | 2.85E-03 |
| 17.91 | 0.92 | 113 | 6.24E-03 | 4973066 | 4973066 | 6993374 | 7459599 | 3.03E-03 | 3.03E-03 | 2.85E-03 | 2.81E-03 |
| 19.09 | 0.98 | 123 | 5.98E-03 | 5300716 | 5300716 | 7454132 | 7951075 | 2.99E-03 | 2.99E-03 | 2.81E-03 | 2.78E-03 |
| 20.29 | 1.05 | 135 | 5.81E-03 | 5633920 | 5633920 | 7922700 | 8450880 | 2.96E-03 | 2.96E-03 | 2.78E-03 | 2.75E-03 |
| 21.49 | 1.11 | 147 | 5.64E-03 | 5967124 | 5967124 | 8391268 | 8950686 | 2.93E-03 | 2.93E-03 | 2.76E-03 | 2.72E-03 |
| 22.68 | 1.17 | 161 | 5.55E-03 | 6297551 | 6297551 | 8855931 | 9446326 | 2.90E-03 | 2.90E-03 | 2.73E-03 | 2.70E-03 |
| 23.87 | 1.23 | 174 | 5.41E-03 | 6627978 | 6627978 | 9320594 | 9941967 | 2.87E-03 | 2.87E-03 | 2.71E-03 | 2.67E-03 |

**Table 14.** Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Frictional Resistance of Model Components | | | | Summed | Equivalent | Model | Model Strut | Model Strut | Sum |
|---|---|---|---|---|---|---|---|---|---|
| RFOm (lbf.) | | | | Σ RFOm | Frictional | Equivalent | Form | Form Drag | RFO+Rform.strut |
| Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | (lbf.) | CFOm | Reynolds # | Cform.strut | (lbf.) | (lbf.) |
| 0.48 | 0.48 | 0.57 | 0.58 | 2.10 | 4.17E-03 | 1019383 | 2.80E-04 | 0.06 | 2.17 |
| 0.56 | 0.56 | 0.66 | 0.68 | 2.47 | 4.09E-03 | 1114906 | 2.80E-04 | 0.07 | 2.54 |
| 0.66 | 0.66 | 0.78 | 0.80 | 2.90 | 4.01E-03 | 1220668 | 2.80E-04 | 0.09 | 2.99 |
| 0.76 | 0.76 | 0.90 | 0.92 | 3.35 | 3.94E-03 | 1323023 | 2.80E-04 | 0.10 | 3.45 |
| 0.87 | 0.86 | 1.03 | 1.05 | 3.81 | 3.88E-03 | 1421969 | 2.80E-04 | 0.12 | 3.93 |
| 0.98 | 0.98 | 1.16 | 1.19 | 4.31 | 3.83E-03 | 1524331 | 2.80E-04 | 0.14 | 4.45 |
| 1.11 | 1.10 | 1.31 | 1.34 | 4.87 | 3.77E-03 | 1630107 | 2.80E-04 | 0.16 | 5.02 |
| 1.24 | 1.23 | 1.46 | 1.50 | 5.43 | 3.73E-03 | 1732475 | 2.80E-04 | 0.18 | 5.60 |
| 1.30 | 1.29 | 1.54 | 1.57 | 5.70 | 3.71E-03 | 1780248 | 2.80E-04 | 0.19 | 5.89 |
| 1.37 | 1.36 | 1.62 | 1.65 | 6.00 | 3.68E-03 | 1831433 | 2.80E-04 | 0.20 | 6.19 |
| 1.44 | 1.43 | 1.70 | 1.74 | 6.30 | 3.66E-03 | 1882619 | 2.80E-04 | 0.21 | 6.51 |
| 1.51 | 1.50 | 1.78 | 1.82 | 6.61 | 3.64E-03 | 1933806 | 2.80E-04 | 0.22 | 6.83 |
| 1.58 | 1.57 | 1.87 | 1.91 | 6.93 | 3.62E-03 | 1984994 | 2.80E-04 | 0.23 | 7.16 |
| 1.65 | 1.64 | 1.96 | 2.00 | 7.25 | 3.60E-03 | 2036181 | 2.80E-04 | 0.25 | 7.50 |
| 1.72 | 1.71 | 2.04 | 2.09 | 7.56 | 3.59E-03 | 2083957 | 2.80E-04 | 0.26 | 7.82 |
| 1.80 | 1.79 | 2.13 | 2.18 | 7.90 | 3.57E-03 | 2135146 | 2.80E-04 | 0.27 | 8.17 |
| 1.96 | 1.95 | 2.32 | 2.38 | 8.61 | 3.54E-03 | 2240939 | 2.80E-04 | 0.30 | 8.91 |
| 2.13 | 2.11 | 2.52 | 2.58 | 9.33 | 3.50E-03 | 2343320 | 2.80E-04 | 0.32 | 9.66 |
| 2.29 | 2.27 | 2.71 | 2.78 | 10.06 | 3.48E-03 | 2442291 | 2.80E-04 | 0.35 | 10.41 |
| 2.47 | 2.45 | 2.92 | 2.99 | 10.83 | 3.45E-03 | 2544676 | 2.80E-04 | 0.38 | 11.21 |
| 2.65 | 2.63 | 3.14 | 3.21 | 11.62 | 3.42E-03 | 2647063 | 2.80E-04 | 0.41 | 12.04 |
| 2.83 | 2.81 | 3.35 | 3.43 | 12.42 | 3.40E-03 | 2746039 | 2.80E-04 | 0.45 | 12.86 |
| 3.02 | 3.00 | 3.58 | 3.67 | 13.27 | 3.37E-03 | 2848429 | 2.80E-04 | 0.48 | 13.75 |
| 3.42 | 3.40 | 4.06 | 4.16 | 15.03 | 3.33E-03 | 3053214 | 2.80E-04 | 0.55 | 15.59 |
| 3.85 | 3.82 | 4.57 | 4.67 | 16.90 | 3.28E-03 | 3258004 | 2.80E-04 | 0.63 | 17.53 |
| 4.28 | 4.25 | 5.09 | 5.21 | 18.84 | 3.25E-03 | 3459386 | 2.80E-04 | 0.71 | 19.54 |
| 4.74 | 4.71 | 5.64 | 5.77 | 20.87 | 3.21E-03 | 3660773 | 2.80E-04 | 0.79 | 21.66 |
| 5.24 | 5.21 | 6.23 | 6.38 | 23.06 | 3.18E-03 | 3868991 | 2.80E-04 | 0.88 | 23.94 |
| 5.75 | 5.71 | 6.83 | 6.99 | 25.28 | 3.15E-03 | 4070386 | 2.80E-04 | 0.98 | 26.26 |
| 6.27 | 6.23 | 7.46 | 7.64 | 27.59 | 3.12E-03 | 4271785 | 2.80E-04 | 1.08 | 28.66 |
| 6.83 | 6.79 | 8.13 | 8.32 | 30.07 | 3.09E-03 | 4480015 | 2.80E-04 | 1.19 | 31.25 |
| 8.00 | 7.95 | 9.53 | 9.76 | 35.23 | 3.04E-03 | 4889658 | 2.80E-04 | 1.41 | 36.65 |
| 9.24 | 9.17 | 11.00 | 11.27 | 40.67 | 3.00E-03 | 5292487 | 2.80E-04 | 1.65 | 42.33 |
| 10.57 | 10.50 | 12.59 | 12.90 | 46.57 | 2.95E-03 | 5702154 | 2.80E-04 | 1.92 | 48.49 |
| 11.99 | 11.91 | 14.29 | 14.64 | 52.82 | 2.92E-03 | 6111833 | 2.80E-04 | 2.21 | 55.02 |
| 13.46 | 13.37 | 16.05 | 16.44 | 59.31 | 2.88E-03 | 6514693 | 2.80E-04 | 2.51 | 61.82 |
| 15.03 | 14.93 | 17.93 | 18.37 | 66.27 | 2.85E-03 | 6924390 | 2.80E-04 | 2.83 | 69.10 |
| 16.69 | 16.57 | 19.91 | 20.40 | 73.57 | 2.82E-03 | 7334096 | 2.80E-04 | 3.18 | 76.75 |
| 18.41 | 18.28 | 21.97 | 22.51 | 81.16 | 2.80E-03 | 7740395 | 2.80E-04 | 3.54 | 84.70 |
| 20.20 | 20.06 | 24.11 | 24.71 | 89.08 | 2.77E-03 | 8146702 | 2.80E-04 | 3.92 | 93.00 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Model | r' = 1.87 | Model | Model | Model Pod | Model Pod | Model | Model | Model | Model |
|---|---|---|---|---|---|---|---|---|---|
| (Frictional + Form) | | Form Drag | Form | Form Drag | Form | Wave Making | Wave Making | Residual | Residual |
| (r'*C.equiv) | R(Rn)m (lbf.) | (lbf.) | Cform.m | (lbf.) | Cform.pod | RWMm (lbf.) | CWMm | RRm (lbf.) | CRm |
| 8.03E-03 | 4.05 | 1.95 | 3.86E-03 | 1.88 | 6.61E-03 | 0.95 | 1.88E-03 | 2.90 | 5.74E-03 |
| 7.88E-03 | 4.75 | 2.28 | 3.79E-03 | 2.21 | 6.49E-03 | 0.25 | 4.10E-04 | 2.53 | 4.20E-03 |
| 7.73E-03 | 5.59 | 2.69 | 3.72E-03 | 2.60 | 6.37E-03 | 0.41 | 5.67E-04 | 3.10 | 4.28E-03 |
| 7.60E-03 | 6.46 | 3.11 | 3.66E-03 | 3.00 | 6.26E-03 | 0.54 | 6.39E-04 | 3.65 | 4.30E-03 |
| 7.49E-03 | 7.35 | 3.54 | 3.61E-03 | 3.42 | 6.17E-03 | 7.65 | 7.80E-03 | 11.19 | 1.14E-02 |
| 7.38E-03 | 8.33 | 4.01 | 3.56E-03 | 3.87 | 6.09E-03 | 15.67 | 1.39E-02 | 19.69 | 1.75E-02 |
| 7.28E-03 | 9.39 | 4.53 | 3.51E-03 | 4.37 | 6.00E-03 | 10.61 | 8.23E-03 | 15.13 | 1.17E-02 |
| 7.20E-03 | 10.48 | 5.05 | 3.47E-03 | 4.88 | 5.93E-03 | 14.52 | 9.97E-03 | 19.57 | 1.34E-02 |
| 7.16E-03 | 11.01 | 5.31 | 3.45E-03 | 5.12 | 5.90E-03 | 22.99 | 1.50E-02 | 28.30 | 1.84E-02 |
| 7.12E-03 | 11.58 | 5.59 | 3.43E-03 | 5.39 | 5.87E-03 | 34.42 | 2.11E-02 | 40.00 | 2.46E-02 |
| 7.08E-03 | 12.17 | 5.87 | 3.41E-03 | 5.66 | 5.83E-03 | 47.83 | 2.78E-02 | 53.70 | 3.12E-02 |
| 7.04E-03 | 12.77 | 6.16 | 3.40E-03 | 5.94 | 5.80E-03 | 60.23 | 3.32E-02 | 66.39 | 3.66E-02 |
| 7.00E-03 | 13.39 | 6.46 | 3.38E-03 | 6.23 | 5.77E-03 | 69.61 | 3.64E-02 | 76.07 | 3.98E-02 |
| 6.97E-03 | 14.02 | 6.77 | 3.36E-03 | 6.52 | 5.74E-03 | 75.98 | 3.78E-02 | 82.75 | 4.11E-02 |
| 6.94E-03 | 14.62 | 7.06 | 3.35E-03 | 6.80 | 5.72E-03 | 79.38 | 3.77E-02 | 86.44 | 4.10E-02 |
| 6.90E-03 | 15.27 | 7.37 | 3.33E-03 | 7.10 | 5.69E-03 | 79.73 | 3.61E-02 | 87.10 | 3.94E-02 |
| 6.84E-03 | 16.66 | 8.05 | 3.30E-03 | 7.75 | 5.64E-03 | 74.34 | 3.05E-02 | 82.39 | 3.38E-02 |
| 6.78E-03 | 18.06 | 8.73 | 3.28E-03 | 8.40 | 5.59E-03 | 64.94 | 2.44E-02 | 73.67 | 2.77E-02 |
| 6.73E-03 | 19.46 | 9.41 | 3.25E-03 | 9.05 | 5.54E-03 | 55.54 | 1.92E-02 | 64.94 | 2.24E-02 |
| 6.67E-03 | 20.96 | 10.14 | 3.23E-03 | 9.75 | 5.50E-03 | 46.04 | 1.47E-02 | 56.17 | 1.79E-02 |
| 6.62E-03 | 22.51 | 10.89 | 3.20E-03 | 10.47 | 5.46E-03 | 39.49 | 1.16E-02 | 50.38 | 1.48E-02 |
| 6.58E-03 | 24.06 | 11.64 | 3.18E-03 | 11.19 | 5.42E-03 | 33.94 | 9.28E-03 | 45.58 | 1.25E-02 |
| 6.53E-03 | 25.70 | 12.44 | 3.16E-03 | 11.96 | 5.38E-03 | 30.30 | 7.70E-03 | 42.73 | 1.09E-02 |
| 6.45E-03 | 29.15 | 14.11 | 3.12E-03 | 13.56 | 5.31E-03 | 25.85 | 5.72E-03 | 39.97 | 8.84E-03 |
| 6.37E-03 | 32.78 | 15.88 | 3.09E-03 | 15.25 | 5.25E-03 | 23.22 | 4.51E-03 | 39.10 | 7.60E-03 |
| 6.30E-03 | 36.55 | 17.71 | 3.05E-03 | 17.00 | 5.19E-03 | 21.45 | 3.70E-03 | 39.16 | 6.75E-03 |
| 6.23E-03 | 40.50 | 19.63 | 3.02E-03 | 18.84 | 5.14E-03 | 19.50 | 3.00E-03 | 39.13 | 6.02E-03 |
| 6.17E-03 | 44.78 | 21.72 | 2.99E-03 | 20.83 | 5.08E-03 | 18.22 | 2.51E-03 | 39.94 | 5.50E-03 |
| 6.11E-03 | 49.10 | 23.82 | 2.97E-03 | 22.84 | 5.04E-03 | 17.90 | 2.23E-03 | 41.72 | 5.19E-03 |
| 6.06E-03 | 53.60 | 26.02 | 2.94E-03 | 24.94 | 4.99E-03 | 16.40 | 1.85E-03 | 42.41 | 4.79E-03 |
| 6.01E-03 | 58.45 | 28.38 | 2.92E-03 | 27.19 | 4.95E-03 | 16.55 | 1.70E-03 | 44.93 | 4.62E-03 |
| 5.91E-03 | 68.53 | 33.29 | 2.87E-03 | 31.88 | 4.87E-03 | 15.47 | 1.34E-03 | 48.77 | 4.21E-03 |
| 5.83E-03 | 79.15 | 38.48 | 2.83E-03 | 36.82 | 4.81E-03 | 13.85 | 1.02E-03 | 52.33 | 3.85E-03 |
| 5.75E-03 | 90.67 | 44.10 | 2.80E-03 | 42.18 | 4.74E-03 | 12.33 | 7.83E-04 | 56.43 | 3.58E-03 |
| 5.68E-03 | 102.89 | 50.08 | 2.77E-03 | 47.87 | 4.68E-03 | 10.11 | 5.58E-04 | 60.18 | 3.32E-03 |
| 5.62E-03 | 115.60 | 56.29 | 2.74E-03 | 53.78 | 4.63E-03 | 7.40 | 3.60E-04 | 63.69 | 3.10E-03 |
| 5.56E-03 | 129.22 | 62.95 | 2.71E-03 | 60.12 | 4.58E-03 | 5.78 | 2.49E-04 | 68.73 | 2.96E-03 |
| 5.51E-03 | 143.52 | 69.95 | 2.68E-03 | 66.77 | 4.54E-03 | 3.48 | 1.33E-04 | 73.43 | 2.82E-03 |
| 5.46E-03 | 158.38 | 77.22 | 2.66E-03 | 73.69 | 4.50E-03 | 2.62 | 9.01E-05 | 79.84 | 2.75E-03 |
| 5.41E-03 | 173.91 | 84.83 | 2.64E-03 | 80.91 | 4.46E-03 | 0.09 | 2.69E-06 | 84.92 | 2.64E-03 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Ship | Ship | Ship | Reynolds #'s for Ship Component Lengths | | | | Ship Hughes Coefficients | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Velocity | Velocity | Froude | L=24.00' | L=24.00' | L=33.75' | L=36.00' | CFOs (no form factor) | | | |
| (fps) | (kts.) | # | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | Fwd Strut | Aft Strut | Fwd Pod | Aft Pod |
| 8.46 | 5.01 | 0.15 | 15868275 | 15868275 | 22314762 | 23802412 | 2.47E-03 | 2.47E-03 | 2.33E-03 | 2.31E-03 |
| 9.25 | 5.48 | 0.17 | 17354267 | 17354267 | 24404438 | 26031401 | 2.43E-03 | 2.43E-03 | 2.30E-03 | 2.28E-03 |
| 10.13 | 6.00 | 0.18 | 18999473 | 18999473 | 26718009 | 28499209 | 2.40E-03 | 2.40E-03 | 2.27E-03 | 2.24E-03 |
| 10.97 | 6.50 | 0.20 | 20591608 | 20591608 | 28956948 | 30887411 | 2.36E-03 | 2.36E-03 | 2.24E-03 | 2.21E-03 |
| 11.79 | 6.98 | 0.21 | 22130671 | 22130671 | 31121256 | 33196007 | 2.34E-03 | 2.34E-03 | 2.21E-03 | 2.19E-03 |
| 12.64 | 7.49 | 0.23 | 23722806 | 23722806 | 33360195 | 35584208 | 2.31E-03 | 2.31E-03 | 2.19E-03 | 2.17E-03 |
| 13.52 | 8.01 | 0.25 | 25368011 | 25368011 | 35673766 | 38052017 | 2.29E-03 | 2.29E-03 | 2.16E-03 | 2.14E-03 |
| 14.37 | 8.51 | 0.26 | 26960146 | 26960146 | 37912705 | 40440219 | 2.26E-03 | 2.26E-03 | 2.14E-03 | 2.12E-03 |
| 14.76 | 8.74 | 0.27 | 27703142 | 27703142 | 38957544 | 41554713 | 2.25E-03 | 2.25E-03 | 2.13E-03 | 2.11E-03 |
| 15.19 | 8.99 | 0.28 | 28499209 | 28499209 | 40077013 | 42748814 | 2.24E-03 | 2.24E-03 | 2.13E-03 | 2.10E-03 |
| 15.61 | 9.24 | 0.28 | 29295277 | 29295277 | 41196483 | 43942915 | 2.23E-03 | 2.23E-03 | 2.12E-03 | 2.09E-03 |
| 16.04 | 9.50 | 0.29 | 30091344 | 30091344 | 42315953 | 45137016 | 2.22E-03 | 2.22E-03 | 2.11E-03 | 2.09E-03 |
| 16.46 | 9.75 | 0.30 | 30887411 | 30887411 | 43435422 | 46331117 | 2.21E-03 | 2.21E-03 | 2.10E-03 | 2.08E-03 |
| 16.89 | 10.00 | 0.31 | 31683479 | 31683479 | 44554892 | 47525218 | 2.21E-03 | 2.21E-03 | 2.09E-03 | 2.07E-03 |
| 17.28 | 10.23 | 0.32 | 32426475 | 32426475 | 45599730 | 48639712 | 2.20E-03 | 2.20E-03 | 2.08E-03 | 2.06E-03 |
| 17.71 | 10.48 | 0.32 | 33222542 | 33222542 | 46719200 | 49833813 | 2.19E-03 | 2.19E-03 | 2.08E-03 | 2.05E-03 |
| 18.58 | 11.00 | 0.34 | 34867748 | 34867748 | 49032770 | 52301622 | 2.17E-03 | 2.17E-03 | 2.06E-03 | 2.04E-03 |
| 19.43 | 11.51 | 0.35 | 36459882 | 36459882 | 51271710 | 54689824 | 2.16E-03 | 2.16E-03 | 2.05E-03 | 2.03E-03 |
| 20.25 | 11.99 | 0.37 | 37998946 | 37998946 | 53436018 | 56998419 | 2.14E-03 | 2.14E-03 | 2.03E-03 | 2.01E-03 |
| 21.10 | 12.49 | 0.38 | 39591080 | 39591080 | 55674957 | 59386621 | 2.13E-03 | 2.13E-03 | 2.02E-03 | 2.00E-03 |
| 21.95 | 13.00 | 0.40 | 41183215 | 41183215 | 57913896 | 61774823 | 2.12E-03 | 2.12E-03 | 2.01E-03 | 1.99E-03 |
| 22.77 | 13.48 | 0.42 | 42722279 | 42722279 | 60078204 | 64083418 | 2.10E-03 | 2.10E-03 | 2.00E-03 | 1.98E-03 |
| 23.62 | 13.98 | 0.43 | 44314413 | 44314413 | 62317144 | 66471620 | 2.09E-03 | 2.09E-03 | 1.99E-03 | 1.97E-03 |
| 25.31 | 14.99 | 0.46 | 47498682 | 47498682 | 66795022 | 71248024 | 2.07E-03 | 2.07E-03 | 1.97E-03 | 1.95E-03 |
| 27.01 | 15.99 | 0.49 | 50682952 | 50682952 | 71272901 | 76024427 | 2.05E-03 | 2.05E-03 | 1.95E-03 | 1.93E-03 |
| 28.68 | 16.98 | 0.52 | 53814150 | 53814150 | 75676148 | 80721224 | 2.03E-03 | 2.03E-03 | 1.93E-03 | 1.91E-03 |
| 30.35 | 17.97 | 0.55 | 56945348 | 56945348 | 80079395 | 85418022 | 2.01E-03 | 2.01E-03 | 1.91E-03 | 1.90E-03 |
| 32.07 | 18.99 | 0.58 | 60182688 | 60182688 | 84631905 | 90274032 | 2.00E-03 | 2.00E-03 | 1.90E-03 | 1.88E-03 |
| 33.74 | 19.98 | 0.62 | 63313886 | 63313886 | 89035152 | 94970829 | 1.98E-03 | 1.98E-03 | 1.88E-03 | 1.87E-03 |
| 35.41 | 20.97 | 0.65 | 66445084 | 66445084 | 93438400 | 99667626 | 1.97E-03 | 1.97E-03 | 1.87E-03 | 1.85E-03 |
| 37.14 | 21.99 | 0.68 | 69682425 | 69682425 | 97990909 | 104523637 | 1.95E-03 | 1.95E-03 | 1.86E-03 | 1.84E-03 |
| 40.53 | 24.00 | 0.74 | 76050963 | 76050963 | 106946667 | 114076444 | 1.93E-03 | 1.93E-03 | 1.83E-03 | 1.82E-03 |
| 43.87 | 25.98 | 0.80 | 82313359 | 82313359 | 115753161 | 123470039 | 1.91E-03 | 1.91E-03 | 1.81E-03 | 1.80E-03 |
| 47.26 | 27.98 | 0.86 | 88681897 | 88681897 | 124708918 | 133022846 | 1.88E-03 | 1.88E-03 | 1.79E-03 | 1.78E-03 |
| 50.66 | 29.99 | 0.92 | 95050436 | 95050436 | 133664675 | 142575654 | 1.87E-03 | 1.87E-03 | 1.78E-03 | 1.76E-03 |
| 53.99 | 31.97 | 0.98 | 101312832 | 101312832 | 142471170 | 151969248 | 1.85E-03 | 1.85E-03 | 1.76E-03 | 1.74E-03 |
| 57.39 | 33.98 | 1.05 | 107681370 | 107681370 | 151426927 | 161522056 | 1.83E-03 | 1.83E-03 | 1.74E-03 | 1.73E-03 |
| 60.78 | 35.99 | 1.11 | 114049909 | 114049909 | 160382684 | 171074863 | 1.82E-03 | 1.82E-03 | 1.73E-03 | 1.72E-03 |
| 64.15 | 37.98 | 1.17 | 120365376 | 120365376 | 169263810 | 180548064 | 1.80E-03 | 1.80E-03 | 1.72E-03 | 1.70E-03 |
| 67.51 | 39.98 | 1.23 | 126680843 | 126680843 | 178144936 | 190021265 | 1.79E-03 | 1.79E-03 | 1.71E-03 | 1.69E-03 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Frictional Resistance of Ship Components | | | | Summed | Equivalent | Ship | Ship Strut | Ship Strut | Sum |
|---|---|---|---|---|---|---|---|---|---|
| RFOs (lbf.) | | | | Σ RFOs | Frictional | Equivalent | Form | Form Drag | RFO+Rform.strut |
| Fwd Strut | Aft Strut | Fwd Pod | Aft Pod | (lbf.) | CFOs | Reynolds # | Cform.strut | (lbf.) | (lbf.) |
| 143 | 142 | 172 | 176 | 633 | 2.39E-03 | 19510913 | 2.80E-04 | 32 | 666 |
| 169 | 168 | 202 | 208 | 746 | 2.35E-03 | 21338704 | 2.80E-04 | 39 | 785 |
| 199 | 198 | 239 | 245 | 881 | 2.32E-03 | 23362384 | 2.80E-04 | 46 | 928 |
| 231 | 229 | 277 | 284 | 1022 | 2.29E-03 | 25320833 | 2.80E-04 | 54 | 1076 |
| 264 | 262 | 317 | 325 | 1167 | 2.26E-03 | 27214042 | 2.80E-04 | 63 | 1230 |
| 300 | 297 | 360 | 369 | 1326 | 2.23E-03 | 29172574 | 2.80E-04 | 72 | 1398 |
| 339 | 336 | 407 | 418 | 1500 | 2.21E-03 | 31196429 | 2.80E-04 | 83 | 1583 |
| 379 | 376 | 455 | 467 | 1678 | 2.19E-03 | 33155034 | 2.80E-04 | 93 | 1771 |
| 398 | 396 | 479 | 491 | 1764 | 2.18E-03 | 34069060 | 2.80E-04 | 99 | 1863 |
| 420 | 417 | 504 | 518 | 1859 | 2.17E-03 | 35048382 | 2.80E-04 | 104 | 1963 |
| 441 | 438 | 531 | 545 | 1955 | 2.16E-03 | 36027711 | 2.80E-04 | 110 | 2066 |
| 464 | 461 | 558 | 572 | 2054 | 2.15E-03 | 37007048 | 2.80E-04 | 116 | 2171 |
| 487 | 483 | 585 | 601 | 2156 | 2.14E-03 | 37986392 | 2.80E-04 | 123 | 2278 |
| 510 | 506 | 613 | 629 | 2259 | 2.13E-03 | 38965742 | 2.80E-04 | 129 | 2388 |
| 532 | 529 | 640 | 657 | 2358 | 2.13E-03 | 39879809 | 2.80E-04 | 135 | 2493 |
| 557 | 553 | 669 | 687 | 2466 | 2.12E-03 | 40859172 | 2.80E-04 | 142 | 2608 |
| 608 | 604 | 732 | 751 | 2696 | 2.10E-03 | 42883210 | 2.80E-04 | 156 | 2852 |
| 661 | 656 | 795 | 816 | 2927 | 2.09E-03 | 44841980 | 2.80E-04 | 171 | 3098 |
| 713 | 708 | 858 | 881 | 3159 | 2.08E-03 | 46735479 | 2.80E-04 | 186 | 3345 |
| 769 | 764 | 926 | 950 | 3408 | 2.06E-03 | 48694293 | 2.80E-04 | 201 | 3609 |
| 827 | 821 | 996 | 1022 | 3665 | 2.05E-03 | 50653128 | 2.80E-04 | 218 | 3883 |
| 885 | 879 | 1065 | 1094 | 3922 | 2.04E-03 | 52546687 | 2.80E-04 | 235 | 4157 |
| 947 | 940 | 1140 | 1170 | 4197 | 2.03E-03 | 54505560 | 2.80E-04 | 252 | 4449 |
| 1076 | 1069 | 1296 | 1330 | 4771 | 2.01E-03 | 58423360 | 2.80E-04 | 290 | 5061 |
| 1213 | 1205 | 1461 | 1500 | 5379 | 1.99E-03 | 62341227 | 2.80E-04 | 330 | 5709 |
| 1355 | 1346 | 1633 | 1676 | 6010 | 1.97E-03 | 66193858 | 2.80E-04 | 372 | 6382 |
| 1504 | 1494 | 1813 | 1862 | 6673 | 1.95E-03 | 70046545 | 2.80E-04 | 417 | 7090 |
| 1666 | 1655 | 2009 | 2062 | 7392 | 1.94E-03 | 74029887 | 2.80E-04 | 465 | 7857 |
| 1830 | 1817 | 2207 | 2266 | 8120 | 1.92E-03 | 77882679 | 2.80E-04 | 515 | 8635 |
| 2001 | 1987 | 2413 | 2478 | 8879 | 1.91E-03 | 81735518 | 2.80E-04 | 567 | 9447 |
| 2185 | 2170 | 2636 | 2706 | 9697 | 1.89E-03 | 85719008 | 2.80E-04 | 624 | 10321 |
| 2569 | 2551 | 3100 | 3183 | 11403 | 1.87E-03 | 93555512 | 2.80E-04 | 743 | 12147 |
| 2974 | 2954 | 3590 | 3687 | 13206 | 1.85E-03 | 101261561 | 2.80E-04 | 871 | 14076 |
| 3415 | 3391 | 4123 | 4234 | 15163 | 1.83E-03 | 109098365 | 2.80E-04 | 1011 | 16174 |
| 3883 | 3856 | 4690 | 4816 | 17246 | 1.81E-03 | 116935301 | 2.80E-04 | 1161 | 18407 |
| 4371 | 4341 | 5280 | 5423 | 19415 | 1.79E-03 | 124641742 | 2.80E-04 | 1319 | 20734 |
| 4894 | 4861 | 5914 | 6074 | 21742 | 1.78E-03 | 132478913 | 2.80E-04 | 1490 | 23232 |
| 5445 | 5407 | 6580 | 6759 | 24191 | 1.76E-03 | 140316191 | 2.80E-04 | 1672 | 25863 |
| 6018 | 5976 | 7274 | 7471 | 26739 | 1.75E-03 | 148088257 | 2.80E-04 | 1862 | 28601 |
| 6617 | 6572 | 8000 | 8217 | 29406 | 1.74E-03 | 155860415 | 2.80E-04 | 2062 | 31468 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Ship | r' = 1.87 | Ship | Ship | Ship Pod | Ship Pod | Ship | Ship |
|---|---|---|---|---|---|---|---|
| (Frictional + Form) | | Form Drag | Form | Form Drag | Form | Wave Making | Wave Making |
| (r'*C.equiv) | (lbf.) | (lbf.) | Cform.s | (lbf.) | Cform.pod | CWMs | RWMs (lbf.) |
| 4.69E-03 | 1245 | 611 | 2.30E-03 | 579 | 3.86E-03 | 1.88E-03 | 500 |
| 4.62E-03 | 1468 | 722 | 2.27E-03 | 683 | 3.81E-03 | 4.10E-04 | 130 |
| 4.56E-03 | 1735 | 854 | 2.24E-03 | 807 | 3.76E-03 | 5.67E-04 | 216 |
| 4.50E-03 | 2013 | 991 | 2.22E-03 | 936 | 3.71E-03 | 6.39E-04 | 286 |
| 4.45E-03 | 2300 | 1133 | 2.19E-03 | 1070 | 3.67E-03 | 7.80E-03 | 4026 |
| 4.41E-03 | 2615 | 1289 | 2.17E-03 | 1216 | 3.63E-03 | 1.39E-02 | 8248 |
| 4.36E-03 | 2960 | 1460 | 2.15E-03 | 1377 | 3.59E-03 | 8.23E-03 | 5582 |
| 4.32E-03 | 3312 | 1634 | 2.13E-03 | 1541 | 3.56E-03 | 9.97E-03 | 7641 |
| 4.30E-03 | 3483 | 1719 | 2.12E-03 | 1621 | 3.55E-03 | 1.50E-02 | 12100 |
| 4.29E-03 | 3671 | 1812 | 2.12E-03 | 1708 | 3.53E-03 | 2.11E-02 | 18112 |
| 4.27E-03 | 3863 | 1907 | 2.11E-03 | 1797 | 3.52E-03 | 2.78E-02 | 25169 |
| 4.25E-03 | 4059 | 2005 | 2.10E-03 | 1889 | 3.50E-03 | 3.32E-02 | 31693 |
| 4.24E-03 | 4260 | 2105 | 2.09E-03 | 1982 | 3.49E-03 | 3.64E-02 | 36631 |
| 4.22E-03 | 4466 | 2207 | 2.08E-03 | 2078 | 3.48E-03 | 3.78E-02 | 39984 |
| 4.20E-03 | 4662 | 2304 | 2.08E-03 | 2169 | 3.47E-03 | 3.77E-02 | 41773 |
| 4.19E-03 | 4876 | 2410 | 2.07E-03 | 2269 | 3.45E-03 | 3.61E-02 | 41956 |
| 4.16E-03 | 5333 | 2637 | 2.06E-03 | 2481 | 3.43E-03 | 3.05E-02 | 39118 |
| 4.13E-03 | 5793 | 2866 | 2.04E-03 | 2695 | 3.41E-03 | 2.44E-02 | 34172 |
| 4.11E-03 | 6255 | 3096 | 2.03E-03 | 2910 | 3.39E-03 | 1.92E-02 | 29225 |
| 4.08E-03 | 6750 | 3342 | 2.02E-03 | 3140 | 3.37E-03 | 1.47E-02 | 24226 |
| 4.06E-03 | 7262 | 3597 | 2.01E-03 | 3379 | 3.35E-03 | 1.16E-02 | 20780 |
| 4.04E-03 | 7774 | 3851 | 2.00E-03 | 3617 | 3.33E-03 | 9.28E-03 | 17862 |
| 4.02E-03 | 8320 | 4123 | 1.99E-03 | 3871 | 3.31E-03 | 7.70E-03 | 15943 |
| 3.98E-03 | 9464 | 4693 | 1.97E-03 | 4403 | 3.28E-03 | 5.72E-03 | 13605 |
| 3.94E-03 | 10676 | 5297 | 1.96E-03 | 4967 | 3.25E-03 | 4.51E-03 | 12217 |
| 3.91E-03 | 11935 | 5925 | 1.94E-03 | 5552 | 3.22E-03 | 3.70E-03 | 11288 |
| 3.88E-03 | 13258 | 6585 | 1.93E-03 | 6168 | 3.20E-03 | 3.00E-03 | 10262 |
| 3.85E-03 | 14693 | 7301 | 1.91E-03 | 6836 | 3.17E-03 | 2.51E-03 | 9590 |
| 3.82E-03 | 16147 | 8028 | 1.90E-03 | 7512 | 3.15E-03 | 2.23E-03 | 9420 |
| 3.79E-03 | 17665 | 8786 | 1.89E-03 | 8218 | 3.13E-03 | 1.85E-03 | 8629 |
| 3.77E-03 | 19301 | 9603 | 1.88E-03 | 8979 | 3.11E-03 | 1.70E-03 | 8712 |
| 3.72E-03 | 22714 | 11311 | 1.85E-03 | 10568 | 3.07E-03 | 1.34E-03 | 8142 |
| 3.68E-03 | 26323 | 13117 | 1.84E-03 | 12246 | 3.04E-03 | 1.02E-03 | 7287 |
| 3.65E-03 | 30245 | 15082 | 1.82E-03 | 14071 | 3.01E-03 | 7.83E-04 | 6489 |
| 3.61E-03 | 34421 | 17175 | 1.80E-03 | 16014 | 2.98E-03 | 5.58E-04 | 5318 |
| 3.58E-03 | 38772 | 19357 | 1.79E-03 | 18038 | 2.95E-03 | 3.60E-04 | 3892 |
| 3.55E-03 | 43444 | 21702 | 1.78E-03 | 20212 | 2.93E-03 | 2.49E-04 | 3043 |
| 3.53E-03 | 48363 | 24172 | 1.76E-03 | 22500 | 2.91E-03 | 1.33E-04 | 1830 |
| 3.50E-03 | 53484 | 26745 | 1.75E-03 | 24883 | 2.89E-03 | 9.01E-05 | 1377 |
| 3.48E-03 | 58845 | 29440 | 1.74E-03 | 27377 | 2.87E-03 | 2.69E-06 | 46 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Ship Residual RRs (lbf.) | Ship Residual CRs | Ship Allowance CA | Ship Allowance RAs (lbf.) | Ship Total Resistance RTs(lbf.) | Ship Total CTs | EHP (hp) | SHP (hp) |
|---|---|---|---|---|---|---|---|
| 1112 | 4.19E-03 | 0.0005 | 133 | 1878 | 7.07E-03 | 29 | 40 |
| 852 | 2.68E-03 | 0.0005 | 159 | 1757 | 5.53E-03 | 30 | 40 |
| 1070 | 2.81E-03 | 0.0005 | 190 | 2141 | 5.63E-03 | 39 | 54 |
| 1277 | 2.86E-03 | 0.0005 | 224 | 2522 | 5.64E-03 | 50 | 69 |
| 5159 | 9.99E-03 | 0.0005 | 258 | 6584 | 1.27E-02 | 141 | 193 |
| 9537 | 1.61E-02 | 0.0005 | 297 | 11159 | 1.88E-02 | 257 | 351 |
| 7041 | 1.04E-02 | 0.0005 | 339 | 8881 | 1.31E-02 | 218 | 299 |
| 9275 | 1.21E-02 | 0.0005 | 383 | 11336 | 1.48E-02 | 296 | 406 |
| 13819 | 1.71E-02 | 0.0005 | 405 | 15988 | 1.98E-02 | 429 | 588 |
| 19924 | 2.33E-02 | 0.0005 | 428 | 22211 | 2.59E-02 | 613 | 840 |
| 27076 | 2.99E-02 | 0.0005 | 452 | 29484 | 3.26E-02 | 837 | 1147 |
| 33697 | 3.53E-02 | 0.0005 | 477 | 36229 | 3.79E-02 | 1056 | 1447 |
| 38736 | 3.85E-02 | 0.0005 | 503 | 41394 | 4.11E-02 | 1239 | 1697 |
| 42190 | 3.99E-02 | 0.0005 | 529 | 44979 | 4.25E-02 | 1381 | 1892 |
| 44078 | 3.98E-02 | 0.0005 | 554 | 46990 | 4.24E-02 | 1476 | 2023 |
| 44366 | 3.81E-02 | 0.0005 | 582 | 47414 | 4.07E-02 | 1526 | 2091 |
| 41756 | 3.26E-02 | 0.0005 | 641 | 45092 | 3.52E-02 | 1524 | 2087 |
| 37038 | 2.64E-02 | 0.0005 | 701 | 40666 | 2.90E-02 | 1437 | 1968 |
| 32321 | 2.12E-02 | 0.0005 | 761 | 36241 | 2.38E-02 | 1334 | 1828 |
| 27568 | 1.67E-02 | 0.0005 | 826 | 31802 | 1.92E-02 | 1220 | 1671 |
| 24376 | 1.36E-02 | 0.0005 | 894 | 28936 | 1.62E-02 | 1155 | 1582 |
| 21713 | 1.13E-02 | 0.0005 | 962 | 26598 | 1.38E-02 | 1101 | 1508 |
| 20066 | 9.69E-03 | 0.0005 | 1035 | 25298 | 1.22E-02 | 1086 | 1488 |
| 18298 | 7.69E-03 | 0.0005 | 1189 | 24259 | 1.02E-02 | 1117 | 1529 |
| 17515 | 6.47E-03 | 0.0005 | 1354 | 24248 | 8.95E-03 | 1191 | 1631 |
| 17213 | 5.64E-03 | 0.0005 | 1527 | 24750 | 8.11E-03 | 1291 | 1768 |
| 16847 | 4.93E-03 | 0.0005 | 1710 | 25229 | 7.38E-03 | 1392 | 1907 |
| 16891 | 4.42E-03 | 0.0005 | 1910 | 26193 | 6.86E-03 | 1527 | 2092 |
| 17448 | 4.13E-03 | 0.0005 | 2113 | 27681 | 6.55E-03 | 1698 | 2326 |
| 17415 | 3.74E-03 | 0.0005 | 2328 | 28622 | 6.15E-03 | 1843 | 2524 |
| 18315 | 3.58E-03 | 0.0005 | 2560 | 30572 | 5.97E-03 | 2064 | 2828 |
| 19453 | 3.19E-03 | 0.0005 | 3049 | 33905 | 5.56E-03 | 2499 | 3423 |
| 20404 | 2.86E-03 | 0.0005 | 3572 | 37182 | 5.20E-03 | 2966 | 4063 |
| 21571 | 2.60E-03 | 0.0005 | 4146 | 40881 | 4.93E-03 | 3513 | 4812 |
| 22493 | 2.36E-03 | 0.0005 | 4763 | 44502 | 4.67E-03 | 4099 | 5615 |
| 23250 | 2.15E-03 | 0.0005 | 5411 | 48076 | 4.44E-03 | 4720 | 6465 |
| 24745 | 2.02E-03 | 0.0005 | 6113 | 52600 | 4.30E-03 | 5488 | 7518 |
| 26002 | 1.90E-03 | 0.0005 | 6858 | 57051 | 4.16E-03 | 6305 | 8637 |
| 28121 | 1.84E-03 | 0.0005 | 7638 | 62499 | 4.09E-03 | 7289 | 9986 |
| 29485 | 1.74E-03 | 0.0005 | 8461 | 67351 | 3.98E-03 | 8268 | 11326 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

| Model Rn Scaled (lbf.) | Model Rn Scaled C | Model Fn RWMm (lbf.) | Model Fn CWMm C | Model Strut Form (lbf.) | Constant Strut Form C | Model Fn (lbf.) | Model Fn+Const Scaled C | Ship Rn Scaled (lbf.) | Ship Rn Scaled C | Ship Fn RWMs (lbf.) | Ship Fn CWMs C | Ship Strut Form (lbf.) | Constant Strut Form C | Ship Fn Scaled (lbf.) | Ship Fn+Const Scaled C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.99 | 7.90E-03 | 0.95 | 1.88E-03 | 0.06 | 2.80E-04 | 1.01 | 2.01E-03 | 1212 | 4.57E-03 | 500 | 1.88E-03 | 32 | 2.80E-04 | 533 | 2.01E-03 |
| 4.68 | 7.75E-03 | 0.25 | 4.10E-04 | 0.07 | 2.80E-04 | 0.32 | 5.32E-04 | 1429 | 4.50E-03 | 130 | 4.10E-04 | 39 | 2.80E-04 | 169 | 5.32E-04 |
| 5.50 | 7.61E-03 | 0.41 | 5.67E-04 | 0.09 | 2.80E-04 | 0.50 | 6.89E-04 | 1689 | 4.44E-03 | 216 | 5.67E-04 | 46 | 2.80E-04 | 262 | 6.89E-04 |
| 6.35 | 7.48E-03 | 0.54 | 6.39E-04 | 0.10 | 2.80E-04 | 0.65 | 7.61E-04 | 1958 | 4.38E-03 | 286 | 6.39E-04 | 54 | 2.80E-04 | 340 | 7.61E-04 |
| 7.23 | 7.37E-03 | 7.65 | 7.80E-03 | 0.12 | 2.80E-04 | 7.77 | 7.92E-03 | 2237 | 4.33E-03 | 4026 | 7.80E-03 | 63 | 2.80E-04 | 4089 | 7.92E-03 |
| 8.19 | 7.26E-03 | 15.67 | 1.39E-02 | 0.14 | 2.80E-04 | 15.81 | 1.40E-02 | 2542 | 4.28E-03 | 8248 | 1.39E-02 | 72 | 2.80E-04 | 8320 | 1.40E-02 |
| 9.24 | 7.16E-03 | 10.61 | 8.23E-03 | 0.16 | 2.80E-04 | 10.76 | 8.35E-03 | 2877 | 4.24E-03 | 5582 | 8.23E-03 | 83 | 2.80E-04 | 5664 | 8.35E-03 |
| 10.30 | 7.07E-03 | 14.52 | 9.97E-03 | 0.18 | 2.80E-04 | 14.70 | 1.01E-02 | 3219 | 4.20E-03 | 7641 | 9.97E-03 | 93 | 2.80E-04 | 7734 | 1.01E-02 |
| 10.82 | 7.03E-03 | 22.99 | 1.50E-02 | 0.19 | 2.80E-04 | 23.18 | 1.51E-02 | 3385 | 4.18E-03 | 12100 | 1.50E-02 | 99 | 2.80E-04 | 12199 | 1.51E-02 |
| 11.38 | 6.99E-03 | 34.42 | 2.11E-02 | 0.20 | 2.80E-04 | 34.62 | 2.13E-02 | 3566 | 4.16E-03 | 18112 | 2.11E-02 | 104 | 2.80E-04 | 18216 | 2.13E-02 |
| 11.96 | 6.96E-03 | 47.83 | 2.78E-02 | 0.21 | 2.80E-04 | 48.04 | 2.79E-02 | 3752 | 4.15E-03 | 25169 | 2.78E-02 | 110 | 2.80E-04 | 25279 | 2.79E-02 |
| 12.55 | 6.92E-03 | 60.23 | 3.32E-02 | 0.22 | 2.80E-04 | 60.45 | 3.33E-02 | 3943 | 4.13E-03 | 31693 | 3.32E-02 | 116 | 2.80E-04 | 31809 | 3.33E-02 |
| 13.16 | 6.88E-03 | 69.61 | 3.64E-02 | 0.23 | 2.80E-04 | 69.84 | 3.65E-02 | 4138 | 4.11E-03 | 36631 | 3.64E-02 | 123 | 2.80E-04 | 36753 | 3.65E-02 |
| 13.77 | 6.85E-03 | 75.98 | 3.78E-02 | 0.25 | 2.80E-04 | 76.23 | 3.79E-02 | 4337 | 4.10E-03 | 39984 | 3.78E-02 | 129 | 2.80E-04 | 40113 | 3.79E-02 |
| 14.36 | 6.82E-03 | 79.38 | 3.77E-02 | 0.26 | 2.80E-04 | 79.64 | 3.78E-02 | 4527 | 4.08E-03 | 41773 | 3.77E-02 | 135 | 2.80E-04 | 41909 | 3.78E-02 |
| 15.00 | 6.78E-03 | 79.73 | 3.61E-02 | 0.27 | 2.80E-04 | 80.00 | 3.62E-02 | 4734 | 4.07E-03 | 41956 | 3.61E-02 | 142 | 2.80E-04 | 42097 | 3.62E-02 |
| 16.37 | 6.72E-03 | 74.34 | 3.05E-02 | 0.30 | 2.80E-04 | 74.63 | 3.06E-02 | 5177 | 4.04E-03 | 39118 | 3.05E-02 | 156 | 2.80E-04 | 39274 | 3.06E-02 |
| 17.74 | 6.66E-03 | 64.94 | 2.44E-02 | 0.32 | 2.80E-04 | 65.26 | 2.45E-02 | 5622 | 4.01E-03 | 34172 | 2.44E-02 | 171 | 2.80E-04 | 34343 | 2.45E-02 |
| 19.11 | 6.61E-03 | 55.54 | 1.92E-02 | 0.35 | 2.80E-04 | 55.89 | 1.93E-02 | 6069 | 3.99E-03 | 29225 | 1.92E-02 | 186 | 2.80E-04 | 29411 | 1.93E-02 |
| 20.58 | 6.55E-03 | 46.04 | 1.47E-02 | 0.38 | 2.80E-04 | 46.42 | 1.48E-02 | 6548 | 3.96E-03 | 24226 | 1.47E-02 | 201 | 2.80E-04 | 24428 | 1.48E-02 |
| 22.10 | 6.50E-03 | 39.49 | 1.16E-02 | 0.41 | 2.80E-04 | 39.90 | 1.17E-02 | 7044 | 3.94E-03 | 20780 | 1.16E-02 | 218 | 2.80E-04 | 20998 | 1.17E-02 |
| 23.61 | 6.46E-03 | 33.94 | 9.28E-03 | 0.45 | 2.80E-04 | 34.39 | 9.40E-03 | 7539 | 3.92E-03 | 17862 | 9.28E-03 | 235 | 2.80E-04 | 18097 | 9.40E-03 |
| 25.22 | 6.41E-03 | 30.30 | 7.70E-03 | 0.48 | 2.80E-04 | 30.78 | 7.82E-03 | 8068 | 3.90E-03 | 15943 | 7.70E-03 | 252 | 2.80E-04 | 16195 | 7.82E-03 |
| 28.59 | 6.33E-03 | 25.85 | 5.72E-03 | 0.55 | 2.80E-04 | 26.41 | 5.84E-03 | 9174 | 3.86E-03 | 13605 | 5.72E-03 | 290 | 2.80E-04 | 13895 | 5.84E-03 |
| 32.16 | 6.25E-03 | 23.22 | 4.51E-03 | 0.63 | 2.80E-04 | 23.84 | 4.63E-03 | 10346 | 3.82E-03 | 12217 | 4.51E-03 | 330 | 2.80E-04 | 12547 | 4.63E-03 |
| 35.84 | 6.18E-03 | 21.45 | 3.70E-03 | 0.71 | 2.80E-04 | 22.16 | 3.82E-03 | 11562 | 3.79E-03 | 11288 | 3.70E-03 | 372 | 2.80E-04 | 11661 | 3.82E-03 |
| 39.71 | 6.11E-03 | 19.50 | 3.00E-03 | 0.79 | 2.80E-04 | 20.29 | 3.12E-03 | 12841 | 3.76E-03 | 10262 | 3.00E-03 | 417 | 2.80E-04 | 10679 | 3.12E-03 |
| 43.89 | 6.05E-03 | 18.22 | 2.51E-03 | 0.88 | 2.80E-04 | 19.11 | 2.63E-03 | 14228 | 3.73E-03 | 9590 | 2.51E-03 | 465 | 2.80E-04 | 10055 | 2.63E-03 |
| 48.12 | 5.99E-03 | 17.90 | 2.23E-03 | 0.98 | 2.80E-04 | 18.88 | 2.35E-03 | 15632 | 3.70E-03 | 9420 | 2.23E-03 | 515 | 2.80E-04 | 9935 | 2.35E-03 |
| 52.52 | 5.94E-03 | 16.40 | 1.85E-03 | 1.08 | 2.80E-04 | 17.48 | 1.98E-03 | 17098 | 3.67E-03 | 8629 | 1.85E-03 | 567 | 2.80E-04 | 9197 | 1.98E-03 |
| 57.26 | 5.89E-03 | 16.55 | 1.70E-03 | 1.19 | 2.80E-04 | 17.74 | 1.82E-03 | 18677 | 3.65E-03 | 8712 | 1.70E-03 | 624 | 2.80E-04 | 9336 | 1.82E-03 |
| 67.12 | 5.79E-03 | 15.47 | 1.34E-03 | 1.41 | 2.80E-04 | 16.88 | 1.46E-03 | 21971 | 3.60E-03 | 8142 | 1.34E-03 | 743 | 2.80E-04 | 8885 | 1.46E-03 |
| 77.50 | 5.71E-03 | 13.85 | 1.02E-03 | 1.65 | 2.80E-04 | 15.50 | 1.14E-03 | 25452 | 3.56E-03 | 7287 | 1.02E-03 | 871 | 2.80E-04 | 8158 | 1.14E-03 |
| 88.75 | 5.63E-03 | 12.33 | 7.83E-04 | 1.92 | 2.80E-04 | 14.25 | 9.04E-04 | 29235 | 3.53E-03 | 6489 | 7.83E-04 | 1011 | 2.80E-04 | 7500 | 9.04E-04 |
| 100.69 | 5.56E-03 | 10.11 | 5.58E-04 | 2.21 | 2.80E-04 | 12.31 | 6.80E-04 | 33260 | 3.49E-03 | 5318 | 5.58E-04 | 1161 | 2.80E-04 | 6479 | 6.80E-04 |
| 113.10 | 5.50E-03 | 7.40 | 3.60E-04 | 2.51 | 2.80E-04 | 9.90 | 4.82E-04 | 37453 | 3.46E-03 | 3892 | 3.60E-04 | 1319 | 2.80E-04 | 5211 | 4.82E-04 |
| 126.39 | 5.44E-03 | 5.78 | 2.49E-04 | 2.83 | 2.80E-04 | 8.61 | 3.71E-04 | 41954 | 3.43E-03 | 3043 | 2.49E-04 | 1490 | 2.80E-04 | 4533 | 3.71E-04 |
| 140.35 | 5.38E-03 | 3.48 | 1.33E-04 | 3.18 | 2.80E-04 | 6.65 | 2.55E-04 | 46691 | 3.40E-03 | 1830 | 1.33E-04 | 1672 | 2.80E-04 | 3502 | 2.55E-04 |
| 154.85 | 5.33E-03 | 2.62 | 9.01E-05 | 3.54 | 2.80E-04 | 6.15 | 2.12E-04 | 51622 | 3.38E-03 | 1377 | 9.01E-05 | 1862 | 2.80E-04 | 3239 | 2.12E-04 |
| 169.99 | 5.29E-03 | 0.09 | 2.69E-06 | 3.92 | 2.80E-04 | 4.01 | 1.25E-04 | 56783 | 3.36E-03 | 46 | 2.69E-06 | 2062 | 2.80E-04 | 2108 | 1.25E-04 |

**Table 14**. Modified Hughes resistance calculations for a sectionalized hull analysis of the SLICE.

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